Vol. 50 No. 2 October 1956

Quarterly

of the

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Vol. 50 No. 2 October 1956

Quarterly

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The NFPA is a non-profit technical and educational organization devoted to the reduction of loss of life and property by fire with a total membership of over 16,000. The *Quarterly* is one of the publications regularly provided to members. Other membership publications include *Fire News*, *Advance Reports* to the Annual Meeting, a *Year Book*, and many leaflets, pamphlets and posters issued throughout the year on fire prevention and control. Six volumes of the National Fire Codes are available on an annual subscription basis, one volume free and others at reduced membership rates. For full details on available material ask for the free "List of NFPA Publications."

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of the

NATIONAL FIRE PROTECTION ASSOCIATION

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Articles and accounts of fires appearing in the Quarterly are based on material forwarded to the Association. The Association, as a body, does not assume responsibility for the accuracy of the material printed herein.

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Lester Williams, Amarillo Daily News

Aerial view shows the variety of tanks in the tank farm of the Shamrock Oil and Gas Corporation's McKee Refinery near Amarillo, Texas. The diesel and crude oil tanks (ignited following the rupture of a spheroid at "A") are still burning. In the right center (at "B") is the companion spheroid to the one destroyed.

Texas Refinery Tragedy

By Miles E. Woodworth

NFPA Flammable Liquids Field Engineer

Nineteen fire fighters died when vapors from about 500,000 gallons of a mixture of pentane and hexane escaped suddenly from a ruptured spheroid tank in a huge ball of fire. The accident occurred at the McKee Refinery of the Shamrock Oil and Gas Corporation about 55 miles north of Amarillo and located between Dumas and Sun Ray, Texas. Rupture of the spheroid followed by about an hour the original fire alarm given at 5:45 A.M. on Sunday morning, July 29, 1956.

Flame impingement from burning vapors issuing from a vent on the spheroid weakened the metal on the top plate above the tank vapor space and this was responsible for the violent rupture of the tank. The lives were snuffed out by the heat wave resulting from the bulk release and ignition of the flammable vapors and over 30 other people, many spectators, were burned although some were standing 1,200 feet away when the spheroid failed.

The Dumas and Sun Ray volunteer fire departments had responded to an early morning call for assistance to fight a fire at the oil refinery located between the two towns. The two departments and the refinery's own fire squad were fighting a combination ground and vent fire when the tank ruptured violently releasing all of its highly flammable and volatile contents. Of those killed seven were members of the Dumas Fire Department, eight from the Sun Ray Fire Department and four from the plant's fire squad. With the exception of the Dumas Fire Marshal, the fire departments were manned with volunteer firemen, several of whom worked for other oil or gas companies in the area and four worked for the refinery which had the fire. The physical damage property loss is estimated at $500,000.

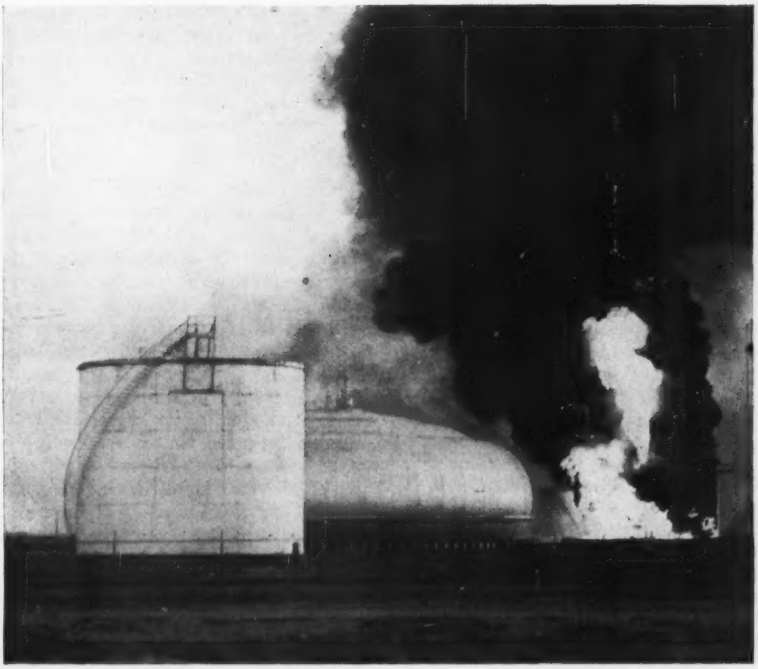
Description of Property

The modern small refinery is situated in an isolated location approximately eleven miles from the town of Dumas and seven miles from Sun Ray. The tank farm is separated approximately 500 feet from the refinery process area by railroad tracks and a dip in the terrain. The tank farm property slopes away from the highway that borders one side (south). All tanks are well spaced, individually diked, modern and include such types as: floating roof, cone roof, spheroids and noded spheroids.

The tanks held a variety of products from crude oil to finished products. The spheroid involved in the original fire was one of two identical tanks designed for 15 pounds-per-square-inch working pressure, built in 1940. Each of these spheroids was equipped with two 6-inch pressure-vacuum vents set at 15 psi connected to an 8-inch vent and tee connection. Both vents were equipped with *return bend weather hoods*. In case of vapor ignition at the vents, as occurred in this case, there would result a direct flame impingement onto the top of the tank in the vapor space. Other openings in the top of each tank were a bolted, covered opening and a gauging pipe. The four-inch gauging pipes were approximately eight feet high with a block valve below the sight glass. The gauging device from the spheroid which ruptured was found after the fire about 700 feet away. The block valve in the assembly was closed.

Moore County News

The area in the center around the damaged vehicles was the section of the tank farm where the 19 bodies were found. The piping on the asphalt tank to the right leads to the direct fired heater (at arrow) where the fire originated.



A view of the original fire involving the spheroid (concealed by flame) before it ruptured. The fire was burning at the gauging device and on the ground.

The refinery process area was provided with looped fire mains and fire pumps. However, the tank farm, where this fire occurred, did not have any fire mains or hydrants.

All the product piping in the tank farm was buried except where necessary to make connections to the tanks. There were four underground product lines running through the diked area on the original fire side of the spheroid. All piping was welded steel although some cast iron valves were noted, including a pump with a cast iron casing adjacent to the involved tank and within the diked area.

Operations at Time of Fire

The spheroid had received product pumped from two different tanks. A careful check of all procedures and tank gauging records definitely proved that there could only have been 28 feet 7 inches of product in the 46-foot-high tank or approximately 12,000 barrels of product in the 15,000 barrel tank. The tank had received product from the pumps on the other two tanks, the pump on the tank involved had not been in operation and was by-passed with piping connected to each side of the pump.

The product pumped into the tank was a mixture of pentane and hexane with a Reid Vapor Pressure of 10.2 pounds-per-square-inch absolute. In comparison, gasoline has a Reid Vapor Pressure varying from 7 to 14 lbs.

The vapors of both pentane and hexane are considerably heavier than

air. With air equaling one, the vapor density of pentane is 2.49 and for hexane, 2.975.

The fire was seen to originate at an open-fired heater within the diked area of an asphalt tank approximately 350 feet downhill from the spheroid. A very light south-west wind was blowing towards the asphalt tank. The fire apparently flashed back through the vapor cloud to the spheroid. For the next hour the tank was involved in both a ground fire involving a liquid spill from a possible line leak in the vicinity of the tank's pump and a fire at the gauging device and vents.

Early Fire Fighting Operations

At the time of this investigation, details of the fire fighting operations were uncertain due to the deaths and hospitalization of most of those directly participating in the activity. The following description of the fire fighting operations therefore summarizes the reports of various reputable eyewitnesses.

As previously described, the original fire resulted from ignition of vapors at an open flame device 350 feet away and had involved (1) a product spill in one section of the dike around the spheroid, and (2) the vapors released through the gauging device and two 6-inch vents on the top of the 15,000 barrel tank. The plant fire brigade was severely limited in manpower since the fire occurred early in the morning when the number of available men for fire fighting was at the minimum. For this reason assistance from the volunteer fire departments of Dumas and Sun Ray was requested.

The refinery fire department laid in a hose line from a fire hydrant in the process area to their foam truck. They attempted to use foam to extinguish the ground fire but experienced considerable difficulty due to the intense radiated heat. It was reported that they were attempting to lay in longer foam lines prior to the rupture of the spheroid. The Sun Ray Fire Department laid in a water line on the downhill side of the tank farm and the Dumas Fire Department laid in a line from the upper side. All hose lines were approximately 900 feet in length.

The public fire squads apparently used the water available through their hose lines to keep adjacent tanks cool. At least observers noted that hose streams were played on a cone roof tank containing pitch which was about 150 feet from the involved tank. Another hose line was seen being used to protect a floating roof tank containing gasoline which was approximately 150 feet from the involved tank. It was further reported that a water line was used at least once on the fire-involved tank. Several times during this stage of the fire there were seal fires on an adjacent floating roof gasoline tank which were promptly extinguished.

The Tank Rupture

At 6:53 A.M., or slightly over an hour after the original fire was reported, the top of the spheroid ruptured violently. The flame impingement on the exterior tank surface from the burning vapors issuing from the vent discharge points and possibly from the ground fire caused the metal shell of the spheroid to stretch and eventually fail due to the internal pressure in the tank. The metal thinned out near the weld on the top (head-plate) over a distance of about one-third the circumference of the spheroid at this point. The top of the spheroid was sheared by the force of the internal pressure release but landed within the tank dike. The remaining sections of the spheroid were also completely destroyed but likewise remained within the diked tank area. The entire venting assembly landed outside the dike.

With this sudden failure of the tank top a huge ball of burning vapors was released. Apparently there was a slight warning to the fire fighters since all

Moore County News

Aerial view of the refinery with the Company houses in the foreground. The paint on a few houses was blistered by the radiant heat after the spheroid ruptured.

bodies were found in an area three to four hundred feet from the tank. Many of those injured from burns were spectators standing on the highway over 1,200 feet away. An indication of the intense heat generated by the tank rupture can be judged by the paint which blistered on company houses 3,000 feet away and by the post-fire condition of the leaves on trees as far as a mile way.

The flaming ball of vapors released by the tank rupture resulted in the ignition of one 20,000 barrel diesel oil tank 200 feet away (containing 6,500 barrels of diesel oil) and two 10,000 barrel tanks of crude oil (containing 6,000 to 8,000 barrels in one and 2,000 barrels in the other). These crude oil tanks were 450 feet and 550 feet from the ruptured tank. Why these tanks, which were new cone roofed tanks equipped with flame arresters on the vents, caught fire is one of the minor mysteries of the fire, particularly since other tanks much closer were not ignited and remained relatively undamaged. Also ignited by the fire blast was a railroad trestle approximately 1,250 feet away and two bulldozers were destroyed by fire in the tank farm 1,200 feet away.

Neighborhood Help

Following the tank rupture help of all kinds came from communities many miles from the scene. Among the fire fighters were units from the town of Dalhart, Amarillo Air Force Base and the Chief and men from the Amarillo Fire Department. The Amarillo Air Force Base Fire Department used foam from their airport crash truck to cover the floating roof gasoline tank and extinguish the seal fire. Other units used hose lines on the burning railroad trestle and small piles of burning lumber near the railroad tracks in the refinery area. The three burning tanks were allowed to burn out.

Medical help was rushed to the hospital to care for the 32 burn injuries. Police and National Guard units rapidly set up roadblocks to expedite passage of emergency vehicles of all types. All citizens of the involved communities were extremely cooperative in this emergency. When help was requested, it was freely given. All emergency units were fed through the assistance of the town's women. To the police officials fell the difficult chore of the identification of the 19 badly burned

bodies. However, these police officials were in complete agreement that all of their work was made easier through the wonderful cooperation of all the citizens of the involved communities.

The fires burned out the next day and the refinery was back in operation on the day following the fire. Of the top three management personnel of the refinery, two were hospitalized and one was killed. Top officials of the company came from the home office to keep the plant running.

Conclusions

This is another case which condemns the widely accepted practice of locating tank vents on pressure tanks in such a manner as to permit flame impingement on a tank's vapor space. [See July 1954 QUARTERLY and NFPA Reprint Q48-1 (25 cents)* and Flammable Liquid Fire Loss Bulletin Series 1956-1 (35 cents)**.]

The installation of a fixed water spray system on all pressure storage tanks would eliminate most of the hazard of a tank rupture by keeping the metal in the tank cool. (See the Standards for Water Spray Systems for Fire Protection, NFPA No. 15). Fixed water spray systems assure a flow of the important cooling water over the tank shell which cannot be achieved in any other manner.

Where necessary to fight fires involving any type of pressure tank, the fire fighters should recognize the possibility of a tank rupture and, therefore, the necessity of applying cooling water streams on the tank. If for any reason it is impossible to apply cooling water streams on the tank shell, fire experi-

*Reference is to report on Tank Car Explosion, Institute, West Virginia, June 4, 1954.

**Reference is to report on Tank Explosion, Galena, Maryland, May 18, 1956.

The entire ruptured spheroid's venting assembly, including the pressure-vacuum valves, is shown at left, outside the dike.

A portion of the spheroid containing the roof plate showing the destructive force of the rupture and the resulting fire.

ences in this type of rupture would indicate that all personnel should be removed from an area at least 1,000 feet from the tank and even at this distance, all personnel should be protected.

The location of direct-fired heaters downhill from volatile flammable liquid storage tanks places a source of ignition within the possible path of vapor travel.

Cast iron should not be permitted in any flammable liquid piping, valves or connections.

Several refineries feel that it is safer practice to locate pumps outside of a diked area where they would not be subject to fire exposure.

The installation of adequate fire mains in tank farm areas in refineries has proven its value for necessary fire fighting operations.

Finally, all companies and fire departments should review their fire fighting procedures for fighting pressure storage tank fires. It is hoped that the tragic lessons of this fire will prevent future tragedies of this nature.

Acknowledgments

The NFPA expresses its appreciation to the following without whose cooperation this report could not have been written: Chief Roy Hill, Amarillo Fire Department; Fire Marshal Robert L. Roseberry, Amarillo; Chief Asa Bowen, Dumas Police Department; Sheriff John Easley, Moore County; and to the newspapers, the Moore County News and Amarillo Daily News.

Publicity During Plant Emergencies

By Ralph Winslow, Vice-President

Koppers Company, Incorporated

There are, of course, many phases in any company's public relations program. Great emphasis is placed, day in and day out, on a positive approach — on earning and fostering favorable attitudes on the part of the public toward the company, its goods and services.

Every company must be prepared, however, to cope with bad days when good public relations techniques must be employed to assure that the company's actions are not misunderstood or misinterpreted. One of the worst days of all, of course, is when there is a fire or other disaster involving injuries or fatalities to employees.

Most companies devote their primary efforts to preventing such tragic events. As long as men and machines are less than perfect, however, it is wise to have a public relations or communications plan ready to put into action. An illustration of the bad results engendered by one *poor* public relations effort, and the favorable attitudes created by two *good* "PR" efforts are discussed herein. They constitute "a before and after" example based on factual events occurring within the Koppers Company.

In presenting the facts of the first case, it is not pleasant to have to admit that we "goofed," but that is exactly what we did. The only saving grace is to add, very hastily, that the error was recognized and corrected immediately and we have more than recovered the ground lost by our first blunder.

Based on an address by the author presented during the 60th NFPA Annual Meeting held in Boston, Mass., June 4–8, 1956.

On May 17, 1948, an explosion occurred at the Koppers tar plant in Kearny, New Jersey.* Fire broke out. Ten workers were burned to death. Telephone lines from the plant were jammed with emergency calls. Frightened wives and mothers of the employees swamped the switchboard with incoming calls seeking news of their loved ones. With the lack of any definite public relations program for such an emergency, the Company made some bad mistakes in this crisis.

First of all, newspaper reporters and photographers arriving on the scene, because of fears for their safety, were barred from admittance to the plant and sent to a spot a half-mile away. Secondly, plant officials, as is understandable, were wary about giving out any information because of the liabilities that can ensue from an accident. When the press associations in New York began calling the Company headquarters in Pittsburgh, complaining that they were unable to obtain adequate information from our people in New Jersey, they were assured that the Company would have a public relations staff man on the scene to help them as soon as a plane could get him there. By then, however, the damage was done.

"Company Officials Refused . . ."

The newspaper reactions were far from favorable. This is what appeared in the news columns of the NEWARK EVENING NEWS the next day:

> ". . . Lack of information created a great deal of confusion,

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* See June 1948 NFPA News Letter.

particularly among families of men employed at the plant. The company was swamped with telephone calls from frightened wives and mothers inquiring after their menfolk, but no early list of the men who worked in the building was available to the press from the company.

"Shortly after the fire broke out, newsmen were barred from the scene and sent to wait about a half-mile away. Two Newark News reporters arrived at the blaze shortly after it began, by driving a nurse to the scene . . ."

The NEWARK STAR LEDGER, in its early edition of May 18, said:

"Company officials refused information regarding the cause of the blast or estimate of damage . . ."

The editorial comments in the papers were even more critical than the news columns. In the NEWARK STAR LEDGER on May 19, two days after the accident, this editorial comment appeared:

"No doubt it served the convenience of the officials of the Koppers Company to bar newspaper reporters from the scene of the fatal explosion at the Kearny plant. The action was, however, a disservice to the public.

"Handicapped by this unwise company action, the reporters did their best to give a true picture of the facts to the public. Had they not been handicapped, there would have been far less anxiety among relatives and friends of those fortunate Koppers employees who did not share the terrible fate of their fellows.

"In case of serious accident in an industry employing large numbers of workers, it is decidedly in the public interest to present the facts as speedily and accurately as possible. The morning and early evening editions yesterday were unfairly and inconsiderately handicapped for poor, and possibly selfish, reasons."

And in the NEWARK EVENING NEWS on the same day, another editorial took a similar slap at Koppers. Briefly summarizing what had taken place, the editorial called for a complete explanation of "how a catastrophe of this magnitude and horror could occur in an industrial state that supposedly surrounds its workers with the highest safety standards." The editorial called for "a swift and open marshalling of the facts that will fix responsibility, that will show whether protective laws in New Jersey are adequate, and if adequate, whether such laws and regulations are enforced." In conclusion, the editorial said:

"Emphasis is placed on an open marshalling of facts because for fourteen hours after the tragedy the company refused reporters admittance and thus added to the doubts about what had occurred."

Needless to say, the bitterness of the newspapers and the ill will created in the community hit Koppers where it hurt the most — its integrity, its pride, and its desire to be a good neighbor.

Looking at the disaster in retrospect, it was easy to rationalize that the action of local Company officials was more the result of their concern for the lives of the victims of the blast, and their fear of secondary explosions that might injure the newspaper men themselves, than their desire to ignore the press. The fact was inescapable, however, that the disaster plans which the Company had drawn up in advance did not include provisions for handling of the press and this was a short-sighted policy.

Corrective Step No. 1

Koppers' public relations staff realized that the Company had been remiss in not spelling out for each plant a pub-

lic relations policy, including procedures for dealing with each of the various communications media. Since Koppers has some 70 plants located in 29 states, it is, of course, not feasible to have a public relations specialist at each location. Therefore, an outline of Koppers' policy, the reasons why, and recommendations on what-to-do in various situations were prepared and published in booklet form, with the title of "Meet the Press." Employees are told in this booklet that the newspapers, magazines, radio and television are vital media through which the public is influenced to look with favor or disfavor upon the Company and that it is imperative that Koppers maintain good relations with these media, to understand what they require from the Company, and what Koppers may expect of them. Under such headings as "Telling Our Story with Good Taste," "Reporters Seek Authoritative News Sources," and "Industry Lives in a Goldfish Bowl," the booklet describes Koppers' policy and emphasizes the reasons why Koppers people should cooperate with the press, even though the information being sought is not considered favorable to the Company.

Industry Lives in Goldfish Bowl

It is pointed out that newsmen will seek the best source of information first. If they are denied cooperation, they will seek the next best source. They won't give up easily, because they have a responsibility to their readers to get the facts. If the people who are in the best position to know what happens in a Koppers plant will not talk, there are others who will. Their stories may be garbled, incomplete, or prejudiced, yet they'll be quoted by the press and radio and television in full, perhaps with this brief added line — the saddest line in public relations — "Company officials refused to give out any information." From such a printed statement, readers of the press, or listeners on radio and television are quick to infer that the Company has something to hide — a conclusion totally unwarranted — and a conclusion that would not be drawn if the Company cooperated with the press.

Two pamphlets issued by Koppers to aid their own plant management in handling publicity and sharing in the life of their community.

Hypothetical examples are given in "Meet the Press" showing the type of stories that might appear for public consumption should Koppers people take the wrong attitude toward the press. The booklet also illustrates how cooperation with reporters enables the Company to provide information which places it in a true light even though the basic facts of the story are unpleasant.

In the case of plant disaster, the booklet describes in detail what a plant manager should do in cooperating with the press and other media. Briefly, it is this:

1. Set aside a room at the plant as a press headquarters.

2. Assign one or more Company men to sole task of assisting the press.

3. If possible, take the newspapermen and photographers to the scene of the accident. If this is not possible, the danger of doing so should be fully explained.

4. If, for reasons of safety, the press cannot be taken into the disaster area, the Company representatives should obtain names of the dead and injured, and probable cause of the disaster, and report at frequent intervals to the press.

5. Adequate telephone and working facilities should be provided for the press.

6. No member of the press should be barred from the plant, but should be promptly escorted to the press room.

To establish the plant manager as an authoritative contact at the plant, it is suggested that he get to know the local newspaper and radio editors, their key executives and reporters who cover industrial beats. In case of an accident, Koppers advises its plant managers to take the initiative by calling the newspapers and explaining the facts to them.

Knowing that it would be unusual for a man skilled in plant operations to be skilled also in all the ramifications of public relations and publicity techniques, the booklet goes on to describe the functions of the Company's Public Relations Section, and the help available through that Section. In conclusion, the booklet quite emphatically points out that Koppers "is so operated that it can stand any kind of investigation. But no company can stand constant suspicion — whether it be warranted or not."

The decision to prepare this Manual was dictated by disaster. The worth of having it was dramatically demonstrated several months later, again, unfortunately, by disaster. In contrast to the confusion, bitterness, and criticisms of the Company that resulted from the handling of the explosion of May 17, 1948, here is what happened nine months later after the booklet "Meet the Press" had been accepted as a policy, and a positive program.

Improved PR Performance

On February 15, 1949, a terrific explosion at one of our chemical plants, also located at Kearny, New Jersey, ripped off the roof of one building. The force of the explosion was felt in Lower Manhattan, Brooklyn and Long Island. Two people were injured. One of the victims died later of injuries.

Here was a situation almost identical to the one faced nine months before, except, fortunately, the loss of life was smaller. Immediately putting into operation that policy and program outlined earlier, plant officials set up a press room. At the gate 64 newspapermen, 8 representatives of local radio stations, and 3 representatives of television stations were admitted. Information was given freely and reporters and photographers were allowed to go into the area of the accident just as soon as it was safe for them to do so. Broadcasters, equipped with walkie-talkies, were permitted to go right to the scene. Typewriters and telephones were made available in the press room. Sandwiches and coffee were sent in for the newsmen.

Vital Services

While the community would suffer without our payroll and taxes, it is equally true that our plant could not exist without the community.

Streets and roads are needed to bring employees and supplies to our gates. We must have police protection for our people, and their homes and families. In case of sickness or accidents, we need a hospital nearby. Sanitation, clean water and milk, proper sewage treatment and garbage removal are other services for which we depend upon the municipality.

Fire protection would be a vital requirement even if there were no danger of damage to our plant. The interruption of services and distraction to our employees that would be caused by a major fire in the community would have a direct effect upon Koppers operations.

An illustration of the tangible results of good community relations occurred when fire threatened to destroy an entire Koppers chemical plant. More than 30 *volunteer* fire companies from throughout the county came to our assistance—some without being called—and joined efforts with Company firemen in averting a major disaster.

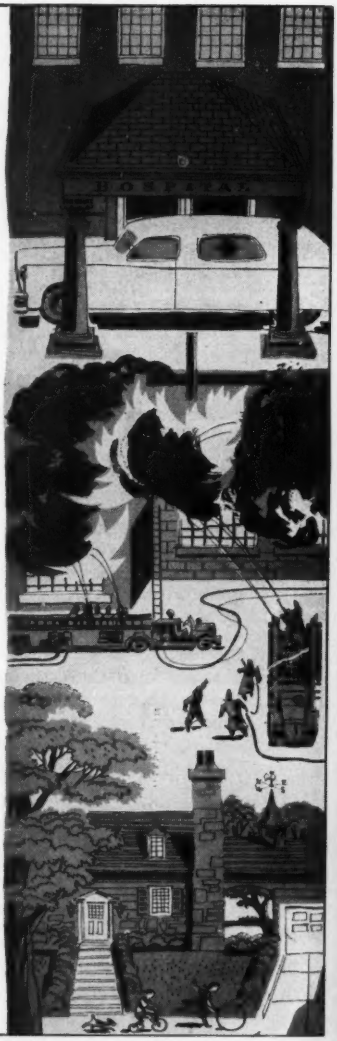
We Live Here

Beyond the impersonal questions of taxes and public services, the community in which Koppers is located is *home* to our employees.

A good school system, proper traffic laws, healthful surroundings and adequate recreational facilities are but a few of the aspects of community life in which Koppers should take an interest as a good citizen.

Not to be overlooked is the personal satisfaction to be gained by Koppers men and women who may represent the Company in working with civic organizations.

Association with other representatives of business, civic and religious organizations and local government in putting across a charity drive or a centennial celebration can be a valuable personal experience and a real factor in developing the qualities of leadership that are so vital in industry.



Typical page from Koppers' booklet "Meet Your Neighbor." Note the emphasis on fire safety under "Vital Services."

Koppers' Press Relations Manager flew from Pittsburgh to Kearny as soon as notification of the explosion was received and worked with the press that night in preparing their "follow-up" stories. In a report to our Chemical Division vice president the next day, these gratifying findings were pointed out: (1). All newspapers and radio editors reported the explosion factually.

There were no instances where a paper or radio station directly or by inference suggested that negligence or inadequacy of equipment or personnel might have contributed to the tragedy. (2). Nothing was found in the broadcasts or news stories that would indicate any dissatisfaction with the method of handling the working press at the time of the emergency.

An editor of the NEWARK NEWS wrote the public relations staff that treatment of newspapermen at the plant was extremely effective. He said, "The Company did everything possible to expedite accurate coverage." A few days later editorials appeared in the HERALD NEWS and THE OBSERVER, both New Jersey newspapers. Here's what the HERALD NEWS said:

> **"A new high mark in press relations when a catastrophe strikes in an industrial plant was established by the Koppers Company recently when a chemical explosion occurred in its Kearny plant."**

The editorial went on to explain how reporters and photographers were treated. "Here was a reporter's dream come true," the editor wrote. This treatment by Koppers was compared with the treatment reporters received nine months before. The editor further commented by saying:

> **"Newsmen who covered the explosion at the same plant last May, when 10 workers were killed, said the management learned a lot about press relations since then."**

Here's what THE OBSERVER said in an editorial:

> **"At long last some of our industrialists have come to realize that the general public is properly entitled to be told of unusual happenings within the confines of Company property, promptly and correctly, particularly if these happenings affect the life and health of employees and the community. It has been our assignment within nine months to twice cover explosions at the Kearny plant. In the earlier explosion, Company officials treated representatives of the press and radio as interlopers who were sticking their noses into other people's business. Nothing was officially made available to the accepted means of communication to the general public for more than 24 hours after the blast which trapped 10 employees in a locker room death pyre. The daily press justifiably criticized editorially the aloofness of Company officials and their reticence in discussing the explosion and its cause with accredited reporters."**

The editorial then goes on to comment on the press handling in connection with the most recent explosion, with nothing but praise. In conclusion, the editor said, "The press salutes the cooperation of the Koppers Company..."

Koppers feels that the press relations program as it applies to the plant city media of communication is only part of an over-all public relations program. In the communities in which our plants are located, an attempt is made to encourage and contribute to civic and industrial progress at the local level. Acting on the sound principle that "good community relations mean good citizenship," our public relations people put together another booklet, "Meet Your Neighbor," based on the idea that a plant town is a home town.

Good PR Pays Off Again

Fire broke out early in the morning at the Company's largest chemical plant in Kobuta, Pa., on March 6, 1951.* Butadiene vapors were ignited by a heater located 185 feet away. Two men

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* See July 1951 Quarterly, page 66.

standing nearby received first degree burns. Because it was not immediately possible to shut off the source of highly volatile fuel, the fire grew in proportions. The plant's 15-man fire brigade was on the scene within two minutes, but there was dire need of more help. Local radio stations were asked to appeal to fire departments throughout the area for that help.

The response was phenomenal and highly gratifying. During the five-and-a-half hours that the fire raged, 21 municipal fire departments, 4 fire fighting companies of industries in the immediate vicinity, ambulances from industry and civic organizations, personnel from five local community police departments and industry, the Salvation Army and the Red Cross responded. Such generous voluntary assistance in a time of real emergency demonstrated the true value of good community relations. To express appreciation and to supplement letters and verbal thanks, the Company used advertisements in the plant town newspapers — the advertisements being headlined "Thank you, Neighbors."

Good community relations, as illustrated in this case history, can have real tangible benefits. At Kobuta a blaze which might have consumed the entire sprawling plant was confined to one section by the help of Koppers' neighbors. When Koppers needed neighbors, they ran to help because the Company had been good neighbors to them. This is typical of the results that accrue from a forthright and positive public relations program.

The American Gas Association's public relations bulletin "Intercom" for July 1956 contains comments of two gas company executives who participated in a Mid-Eastern AGA Public Relations workshop in Atlantic City on June 11, 1956. Mr. Ray T. Ratliff, Director of Advertising and Publicity of The Gas Service Company, Kansas City, Mo., reported on the lessons they learned from a gas outage in Topeka, Kans., on Feb. 23, 1955 affecting 83,000 people. His chief points were:

1. Prepare an emergency plan in advance.
2. During the emergency or as soon as possible, have all news releases and public information come from one person.
3. Keep the public informed on what has happened and what is being done.
4. Have the press and public information center away from the main company offices.
5. Let the public help in any way they can.
6. Ask for and use the help of public officials.

Open-Ended Gas Line Causes 15 Deaths

By Clark F. Jones

NFPA Gases Field Engineer

During the dinner hour on Monday evening, August 13, a tragic explosion destroyed the Lariat Cafe in Monticello, San Juan County, Utah, killing 15 persons and injuring 24. This explosion was reported to have been caused by ignition of an accumulation of liquefied petroleum gas in the basement of the one-story concrete block cafe.

Observers stated that the one-story concrete block cafe building "burst just like an egg shell." The building walls were blown out and the flooring lifted from the joists. There was no subsequent fire. Over 50 persons were reported to have been in the cafe. Deaths and injuries were due to concussions, being struck by flying debris, or crushed by collapsing portions of the building.

Rescue operations were quickly organized immediately following the blast. All the nearby communities in Utah and southwestern Colorado promptly sent help to the disaster scene and the injured were cared for in emergency quarters set up within the town. Hospital facilities in the town of Monticello and other nearby communities were used to the fullest extent.

Deseret News

The LP-Gas 1,000-gallon aboveground tank at "A" supplied the Lariat Cafe ("B") and the apartment house ("C"). When the gas service to the cafe was shifted to natural gas, the line from the LP-Gas tank was cut (but not plugged) and the valve was shut off at the tank. Subsequently someone opened the tank valve to secure fuel for a water heater in the apartment and gas leaked into the cafe basement through the cut line.

Excellent cooperation was prevalent in this whole area with all emergency services operating very effectively.

Preliminary investigations revealed that the LP-Gas service piping in the cafe's basement was not properly capped or plugged on the previous day after the gas service had been shifted from LP-Gas to natural gas.

Monticello, a small community in southeastern Utah, was the first community in Utah to receive natural gas from the Pacific Northwest Pipe Line Company. A local natural gas utility company, Utah Public Service Company, was recently organized to provide natural gas service to communities in the state. Gas distribution lines had been installed throughout Monticello in accordance with the American Standard Code for Gas Transmission and Distribution Piping.* Arrangements were made with the utility to change over to the natural gas service in the cafe on Sunday, the day preceding the explosion, so as not to interfere with business operations. As indicated previously, the cafe used liquefied petroleum gas fuel for cooking. The LP-Gas was supplied to the cafe and to an adjacent apartment house from an outside 1,000-gallon aboveground tank equipped with a regulator. Apparently workmen shut off the LP-Gas system by closing the valve at the tank and then cut, but did not plug, the LP-Gas low pressure gas service line (copper tubing) in the basement of the cafe.

Reports indicate that the new natural gas piping in the building was installed in accordance with NFPA Standard No. 54.** Piping was tested for leaks prior to connection to the gas meter in a standard manner and, since no leaks appeared, the natural gas system was placed in service. Workmen adjusted the burners and pilots and departed. Unfortunately, the LP-Gas supply line was left open-ended and not securely closed gas-tight with a plug or cap in conformance with Paragraph 3(m) of NFPA Standard No. 52.†

Explanation of Explosion

Preliminary investigation disclosed that the low pressure LP-Gas piping coming from the 1,000 gallon LP-Gas tank contained a tee. This tee was provided with a valve on each branch line. One branch of this line supplied the cafe, the other went to the nearby apartment house. Evidently, the apartment house water was heated by an LP-Gas fueled appliance. Since workmen had closed the main LP-Gas supply line, occupants of the apartment house suddenly discovered they were without hot water, and some unknown person turned on the LP-Gas supply at the tank to remedy this situation. This permitted the LP-Gas to enter the cafe's basement through the open-ended tubing. Ignition of escaping LP-Gas and air mixture was probably caused by a pilot or operating burner of the gas-fired equipment in the kitchen of the cafe. Testimony in the investigation has verified the fact that the LP-Gas system was shut off at the tank. However, immediately following the explosion, it was determined that the LP-Gas tank valve was in the open position and it was closed by someone at the scene following the explosion.

Further investigation proceedings are continuing regarding the explosion by local authorities as well as the Public Service Commission and the Industrial Commission of Utah in an effort to determine further pertinent information.

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*Available from American Society of Mechanical Engineers, or the American Gas Association, (ASA B31.1.8-1955) Price $2.50.

**Installation of Gas Piping and Gas Appliances in Buildings (except undiluted LP-Gas), available from NFPA in pamphlet form for 50 cents and published in National Fire Codes, Volume I.

†Installation of LP-Gas Piping and Gas Appliances in Buildings, available from NFPA in pamphlet form for 50 cents and published in National fire Codes, Volume I.

Emergency Lighting for Fire Safety

By Robert S. Moulton

NFPA Technical Secretary

Unexpected darkness is disturbing at any time, and in time of danger, real or imagined, it is conducive to panic. Failure of lighting has been a major contributing factor in many of the notorious fires of the past 50 years.

The Iroquois Theatre fire in Chicago, December 30, 1903, where 602 lives were lost was an example where failure of lights contributed to the panic which greatly aggravated an already dangerous situation. The Cocoanut Grove Night Club fire in Boston, November 28, 1942, with a death toll of 492 was another notorious example. The record continues right into the present; eleven lives were lost when lights failed at a church sponsored oyster roast near Baltimore in January of this year, after a fire started and spread in a ceiling concealed space (see April 1956 QUARTERLY). In these and many other fires loss of life might have occurred even if full illumination had been maintained, but the conclusion is inescapable that panic and resultant loss of life was greatly aggravated in darkness.

Even when there is no fire, and no smoke to cause alarm, failure of lights is disturbing, and sets the stage for panic in any place where any large number of people are crowded together. And the promiscuous lighting of matches by excited people trying to find their way out may start a fire.

Building Exits Code

Lighting of exits, exit signs, and paths of travel to exits is an essential feature of the Building Exits Code (NFPA No. 101). This standard deals with exits and related features of life safety from fire and other emergencies requiring evacuation of buildings in the interest of public safety. The NFPA Committee on Safety to Life, which drafts the Building Exits Code, has always felt that exits alone cannot assure life safety from fire or other emergency; there must be enough lights so that people can find the exits, and see to use them safely.

Public utility electric systems have a high degree of reliability, and provide a satisfactory source for exit lighting for the great majority of buildings. The fact remains, however, that even the most reliable of public utility systems may suffer interruption of service due to hurricanes, floods, earthquakes, breakdowns of electrical equipment or acts of sabotage. Furthermore, even though there is no interruption of the public utility service, lights may and often do fail due to electrical faults within the individual building, or due to human error in operating the wrong switch. The worst situation is when a fire which threatens the lives of building occupants causes failure of the lighting system before they have time to escape. The probability of such occurrences, while mathematically slight, is such as to call for some type of emergency lighting system to assure continuing illumination sufficient for the safe evacuation of the building where large numbers of people congregate.

National Electrical Code

The National Electrical Code, as developed by the National Fire Protection Association and widely used as a basis of legal requirements, has described acceptable ways of providing emergency lighting, but has not at-

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Based on a paper presented before a meeting of the American Institute of Electrical Engineers in San Francisco, Calif., June 25-29, 1956.

tempted to differentiate between the various methods, or to spell out the conditions where emergency lighting facilities are essential in the interest of public safety. There are good and sufficient reasons why the National Electrical Code stops where it does. The Building Exits Code has previously furnished some general guidance as to where and how emergency lighting should be provided, but the wide differences in application of these principles in different jurisdictions have indicated the need for more specific guidance, and this year the Building Exits Code has just been revised to provide specific answers for some of the troublesome questions.

Emergency Vs. General Lighting

Distinction should be made between emergency exit lighting, and general lighting. The Building Exits Code covers only exit lighting, including exits and ways of approach to exits, and lighting for exit signs. While the Building Exits Code does not cover general lighting, its requirements are such as to assure enough light to provide for safe travel to reach exits and thus provides for public safety, as a relatively low level of general illumination should suffice to minimize danger of panic. Emergency lighting sufficient to maintain the normal functions of occupancy, such for example as in hospital operating rooms, is quite another matter. The principles, however, are much the same. Emergency electric supply to continue iron lungs in operation in the event of general power failure, or to maintain critical industrial equipment involves similar principles.

Emergency Power Sources

Before discussing the lighting provisions of the current Building Exits Code, it may be well to consider some of the fundamentals which have often not been fully understood. In the first place, it should be noted that like any type of emergency equipment, a certain degree of attention and maintenance is necessary to assure reliable operation; and that human nature being what it is, the equipment is likely to be found wanting when needed unless regular maintenance procedures are part of someone's paid job. Different methods vary in the amount of maintenance attention needed; the less the degree of attention needed, the greater the reliability.

Dry Cell Batteries

An emergency system depending upon dry cell batteries might be satisfactory if batteries were replaced after every operation of the lights and in any case at specified intervals. It cannot be presumed, however, that the average system will receive this degree of attention, and dry cell batteries are accordingly not recognized as a source of energy for emergency lighting of exits.

Standby Generators

A gasoline engine driven or water motor driven generator is a satisfactory source of emergency power for exit lighting if maintained ready for instant starting, if fully automatic, and if it can reach its operating speed promptly enough so as to avoid any appreciable interval of darkness—conditions which are seldom met in actual practice. A standby generator, on the other hand, may be fully satisfactory to take the load in an occupancy such as a hospital where continuous service must be maintained in the event of general power failure such as in a hurricane or flood. In such cases, a slight delay in putting the emergency generator in operation may not have serious consequences.

Power Outage Vs. Intentional Turn-off

Emergency lighting equipment that comes into operation automatically upon failure of the normal lighting may also come into operation when the building is closed for the night and the lights are turned off. If battery supplied, this means that the batteries may be depleted. In any case continued operation of lights in a closed building is likely to cause concern and result in some action to turn them off, with the consequence that the emergency equipment

may be inoperative the next time the building is occupied. Thus, the automatic equipment should be able to distinguish between a power failure, and normal opening of lighting circuits. An acceptable alternative is an arrangement whereby the auxiliary emergency lighting will operate for the specified period, usually half an hour, and then turn itself off, ready for repeated automatic operation when the building is again occupied and the lights turned on.

One further thought is that electricity, while the principal source of artificial illumination, is not the only source.

Types of Systems

The 1956 Building Exits Code classifies emergency exit lighting in three groups, A, B and C, each suitable for different situations, but without indication of relative superiority, as follows:

Class A Emergency Lighting

5231. Class A emergency lighting shall be so arranged as to provide the required illumination automatically in the event of any failure of normal lighting due to any fault in the main lighting system, due to any failure of public utility or other outside electric power supply, or any single manual act such as accidental opening of a switch controlling normal lighting facilities.

5232. Class A emergency lighting shall be either continuously in operation, or shall be capable of repeated automatic operation without manual intervention. Where maintenance of illumination depends upon changing from one energy source to another, there shall be no appreciable interruption of illumination during the change over.

5233. Class A emergency lighting, subject to the approval of the enforcing authority, may be provided by any method or combination of methods which will produce the desired results, such as:

(1) Two separate electric lighting systems, with independent wiring, each adequate alone to provide the specified exit lighting, one supplied from an outside source such as a public utility service and the other from an electric generator on the premises driven by an independent source of power, both sources of illumination being in regular simultaneous operation whenever the building is occupied during periods of darkness.

(2) An electric circuit or circuits used only for exit illumination, with two independent electric sources so arranged that on the failure of one the other will come automatically and immediately into operation. One such source shall be a connection from a public utility or similar outside power source and the other an approved storage battery with suitable provision to keep it automatically charged. Such battery shall also be so provided with automatic controls that after the battery comes into operation due to failure of the primary power source, or due to turning off the primary electric source for the exit lights, it will be shut off after its specified period of operation and will be automatically recharged and ready for further service when the primary current source is again turned on.

(3) Unit devices with individual batteries providing for the same functions as specified in item (2) above, except that the battery supplied light may be operated on a separate circuit at a voltage different from that of the primary light.

(4) Two separate sources of illumination, one electric and the other of the incandescent gas mantle type, supplied by city gas, propane or gasoline vapor, utilizing only approved gas lighting devices and with reliable arrangements acceptable to the enforcing authority to assure that both gas and electric lighting sources will be in regular continuous operation during occupancy of the building in periods of darkness. Such gas lighting devices shall be so installed as not themselves to create a fire or explosion hazard within the building.

Class B Emergency Lighting

5241. Class B emergency lighting shall be so arranged as to provide the required illumination automatically in the event of any failure of normal lighting due to any

fault within the building, such as opening of a circuit breaker or melting of a fuse due to short circuit due to fire or other cause or due to overloading.

This type of emergency lighting does not necessarily provide any safeguard against outside power failure, but does guard against light failure from causes within the building, and may be found suitable and reasonably adequate for many situations.

5242. Class B emergency lighting shall be either continuously in operation or shall be capable of repeated automatic operation without manual intervention.

5243. Class B emergency lighting may be provided by any method or combination of methods that will produce the desired results, subject to the approval of the enforcing authority, such as an arrangement whereby exit lights are on a separate electric circuit or circuits, used for no purpose other than exit lights and signs, such circuit or circuits being connected to the electric service wires ahead of any circuit breakers or fuses controlling the normal electric supply to the building.

For installation details see National Electrical Code, NFPA No. 70, Article 700.

Class C Emergency Lighting

5251. Class C emergency lighting shall be such as to maintain the required exit illumination automatically in the event of failure of public utility electric service or other outside source of energy.

This type of emergency lighting does not necessarily provide any safeguard against failure of lighting from causes wholly within the building, but may be found suitable for situations where the principal concern is to provide continued light in the event of outside power failure, such as with a public utility service particularly subject to interruption due to storms or other causes.

5252. Class C emergency lighting shall either be continuously in operation while the building is occupied, or shall come into operation automatically, with no appreciable delay, upon failure of current supply for normal lighting and, where automatic, shall be capable of repeated operation without manual intervention.

5253. Class C emergency lighting may be provided by any method or combination of methods that will produce the desired results.

A local electric generating system supplying a single building will meet the requirements for Class C if the local system is itself of adequate reliability, and where such a local system supplies all lights in a building no separate emergency lighting circuits or other special features are necessarily required to furnish Class C emergency lighting.

Where normal lighting is from a public utility or other outside source, it is necessary to have a local source of energy for emergency lighting, or for the entire building, such as an automatic starting electric generator arranged to supply the building in the event of outside power failure. In such a case, however, only a few additional features are needed to qualify the system for Class A emergency lighting, which is obviously preferable.

Summary of Exit Lighting

The following summary illustrates the treatment of emergency exit illumination for various occupancies covered by the Building Exits Code. Illumination from normal lighting sources is required in all cases.

ASSEMBLY OCCUPANCY
- Over 1000 — Class A
- 200-1000 — Class B or Class C
- Under 200 — No requirement except normal lighting.

EDUCATIONAL OCCUPANCY, WHERE SUBJECT TO NIGHT USE
- Class A or Class B

HOSPITALS
- Class A for exits, large wards, etc.
- Class C for existing hospitals

HOTELS
- Over 500 rooms — Class A
- 25-500 rooms — Class B
- Under 25 rooms — No requirement except normal lighting

MERCANTILE OCCUPANCY
- 30,000 sq. ft. or more — Class A or B
- 3,000-30,000 sq. ft. — Class A, B or C
- 3,000 sq. ft. or less, on street level — No requirement except normal lighting

Water Cooling Towers Will Burn!

By Richard E. Stevens
NFPA Engineer

Water cooling towers — essential to many industries yet vulnerable to fire — require protection. Like the other products produced by the air conditioning industry, water cooling towers are becoming more and more useful in the production of all kinds of materials and to public utilities. Petroleum refining, chemical processing, steam-electric generating, iron and steel production and many other industries use water cooling towers as an adjunct to or an essential part of their production.

The fire safety of water cooling towers is influenced by the fact that, for the most part, they are made of wood. A look at the cross section of a wooden cooling tower with its maze of framing, bracing, drift eliminators, baffles, louvres, fillers, decks and other wooden parts, obviates any doubts that cooling towers will burn. It is a fact that when the tower is operating, most of the wood is wet but this depends on the type of tower and does not in many cases include the sides and the top which, after exposure to sun, become very dry.

These statements are not intended as criticisms of the cooling tower industry. On the contrary, the Cooling Tower Institute* has appointed a Subcommittee of their Committee on Engineering Standards to study fire protection requirements. This Subcommittee has offered to coordinate its activities with any that the NFPA might undertake on the matter of protection of cooling towers.

*A non-profit association of industrial cooling tower manufacturers organized in 1950 and with executive offices at 446 Emerson St., Palo Alto, California.

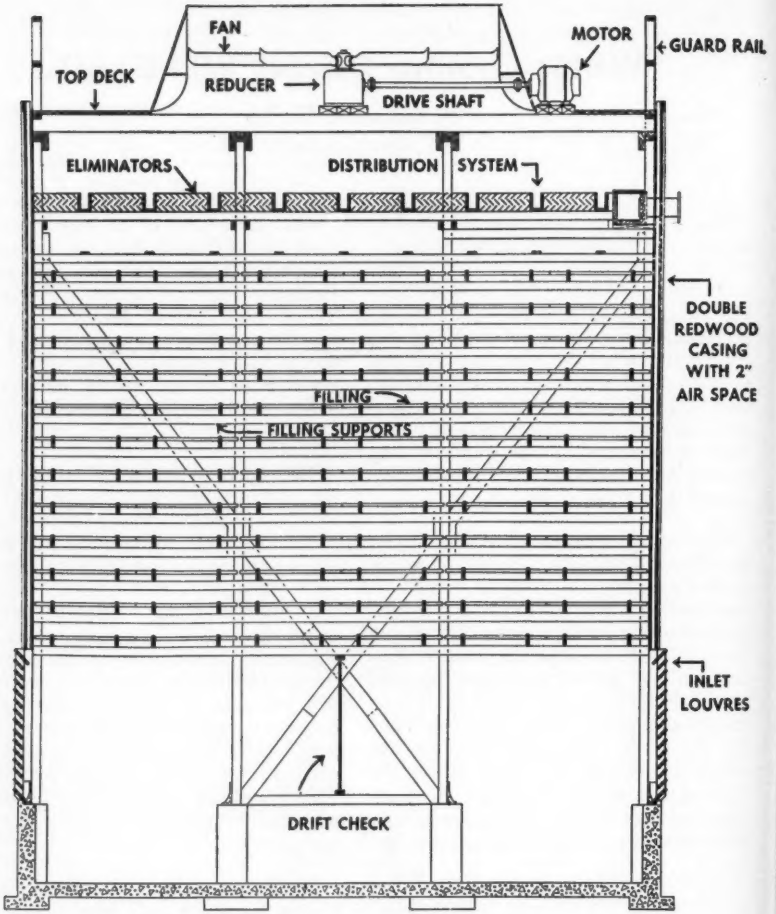
The principle of a water cooling tower is to remove heat from water by passing it in small particles through air. Heat is removed from the water partly by an exchange of latent heat (heat required to pass from liquid to a gas) due to the evaporation of some of the water particles and partly by a transfer of sensible heat (heat required to change the temperature).

The water to be cooled is pumped to the tower where it is distributed uniformly by special spray nozzles, troughs or splash-heads, at or near the top of the tower. The water then cascades over horizontal and vertical "fillers" which slow up the downward progress of the water allowing more exposure to the air. When the water has traversed the height of the tower it is collected in a basin at the bottom. Drift eliminators are installed in the tower to prevent excess loss of water that may be carried off in small particles by the air. This is a general description of a cooling tower but there are many variations in design.

Towers may be all metal, metal framed with wood fillers and drift eliminators, or all wood (redwood is generally used). Some towers have a noncombustible exterior covering. Wood is used in cooling tower construction primarily because of its superior lasting ability and its resistance to corrosion.

Types of Water Cooling Towers

There are three basic types of water cooling towers; atmospheric, induced draft and forced draft. In the atmospheric type of cooling tower, air enters



A typical induced draft cooling tower illustrating significant component parts.

the tower through louvres in the sides, the amount of air movement dependent primarily upon natural wind conditions. The top of the tower is open. Spray-filled atmospheric towers do not have any fillers and the water is broken into small particles by spray nozzles. Atmospheric deck towers have a series of horizontal decks of fillers that break and rebreak the water into particles before it reaches the catch basin.

Induced draft cooling towers, probably the type most commonly used, have large fans electrically driven through speed reducers at the top of the tower that draw air from louvres at or near the bottom of the tower.

In forced draft towers, the air is forced into the cooling tower at the bottom by electrically-driven fans and leaves the tower through the open top.

Fires in Cooling Towers

The belief that most fires in water cooling towers occur when the tower is shut down cannot be substantiated from NFPA fire record files. One insurance company has stated that nearly half of the losses involving towers insured by that company occurred when the towers were in operation.

Fires While Towers Operating

For example, in Flint, Mich., on July 6, 1956, employees of an automobile assembly plant saw smoke coming from the 84 ft. by 42 ft. by 20 ft. wooden, eight section, induced draft cooling tower. The fans were shut down and the fire department called. Forty minutes later when the fire was out, half of the top of the tower was found severely damaged and the remainder of the top damaged in places. Some drift eliminators were burned. It is believed that the fire was caused by an overheated fan bearing. Although there was no interruption to production, it took three days to get six towers back in service, the minimum necessary to operate properly.

A short circuit at an open terminal box at a motor was the cause of fire that destroyed the portion of five sections of a sixteen section induced draft wooden cooling tower. These sections were not wetted during normal operations since in induced draft towers about three feet of the tower above the water distribution heads does not normally get wet. This fire occurred at 2:00 P.M. on May 17, 1956 in Alcoa, Tenn. An employee had tried to start the fan in one of the cooling towers, when the overload switch operated. The employee notified the electrical maintenance department but there was a delay in checking the trouble. At 4:15 P.M. it was noticed that the tower was in flames. Firemen laid 800 ft. of 2½-inch hose to reach the blaze. After the fire, it was determined that the motor lead terminal box cover had been removed sometime prior to the fire and that severe arcing had occurred across two phases, probably due to an insulation failure. Apparently the short circuit ignited the dry wooden top of the tower. Only the prompt action of plant supervisors in cleaning the concrete basin below the cooling tower and getting the remaining cells back in operation prevented a serious plant stoppage.

The top four feet of a 24 ft. by 24 ft. by 40 ft. induced draft wooden cooling tower was destroyed on August 22, 1955, in Detroit, Mich., and the motor and fans severely damaged by fire that originated at an overheated fan bearing. The tower was located on the roof of a reinforced concrete tank house and the water cooled by the tower cooled oil in six large quench oil tanks in the building. When the fire was discovered, the fire department was called and employees laid a 2½-inch hose line from a yard hydrant to the fire scene. Firemen had to carry ladders and hose over the roof of the building to reach the fire. About seven hours of production were lost while temporary arrangements for cooling the quench oil with city water were made.

An induced draft cooling tower 73 ft. by 31 ft. by 32 ft. on the roof of a building was turned on at 7:00 A.M. About 9:20 A.M. an employee saw smoke coming from the top of the tower and notified firemen immediately. The plant fire brigade laid hose lines from standpipes in stairtowers and from a sprinkler riser in an adjacent building and manned these lines until firemen from the public fire department arrived and completed extinguishment of the fire. Hose streams were not very effective until ladders were placed against the tower and hose streams applied into the tower from the ladders. Holes were broken through the noncombustible exterior of the tower to further aid in effective application of water. Investigation revealed that a key on the gear reducer end of the drive shaft had sheared and the friction of the shaft

The top 10 feet of this induced draft cooling tower were destroyed by fire that originated from a mechanical failure in the drive shaft assembly.

turning in the coupling heated the metal to an extent where hot particles dropped into the wooden interior of the tower. Damage to the tower is shown in the photograph.

A 124 ft. by 20 ft. by 18 ft. four section wooden induced draft cooling tower was located on an elevated concrete basin which formed the roof of a below-grade building. The interior framing and redwood fill of the cooling tower and three of the four fans and gear boxes had recently been replaced. Two of the sections were in operation at the time of the fire. Fire was discovered in the cooling tower at 5:10 P.M. on May 5, 1952 by two employees. Two pumpers from the town fire department responded to an alarm and extinguished the fire with three 2½-inch hose streams. Nearly all of the interior fill of the tower was consumed and most of the exterior wall badly charred. Three fans and their gear boxes were destroyed. No positive cause could be determined but it is possible that a carelessly discarded cigarette ignited the tower and the fire smoldered until it progressed to where its spread was accelerated by the operating fan.

The cases just cited all occurred while the towers were in operation and involved three basic ignition sources: electrical defects, mechanical failure and exposure.

Fires While Towers Shut Down

The following cases represent fires that originated while the towers were shut down either for maintenance, overhaul or during normal non-operating periods due to seasonal conditions. These cases reflect hazards mostly from outside sources or exposure sources, such as sparks from incinerators, stacks etc., smoking and sparks from welding and cutting or other hazardous operations prevalent during maintenance of the towers.

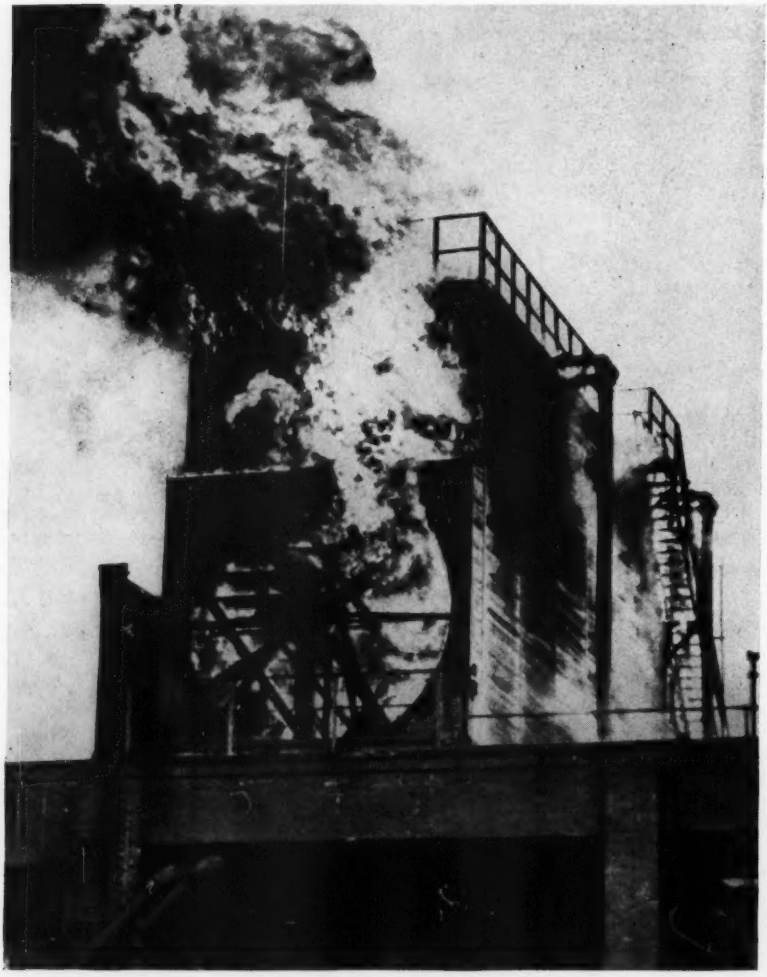
A passing motorist saw fire in the cooling tower on the roof of a 13-story apartment building in Arlington, Va.,

on May 10, 1956. The fire department was called immediately but there was delay in getting water on the flames until firemen could carry hose to the roof of the building and connect to a 4-inch standpipe in a nearby stair-tower. The 18 ft. by 20 ft. by 14 ft. wooden cooling tower, including the fans, motors and wiring, was severely damaged. The fire was believed to have been caused by a spark from an incinerator chimney near the tower. The tower had been shut down for several months.

On June 10, 1955, in Philadelphia, Pa., on the roof of a fire-resistive building housing a publishing company, one of a bank of six wooden induced draft cooling towers was shut down for servicing. At 2:15 P. M. the aluminum fan blades had been removed and also the drive shaft between the motor and the gear reducer. At 6:45 P.M. several hours after workmen had left the tower, an employee saw fire in the tower and summoned the fire department. Fire burned off the top of the entire tower down to the level of the water spray heads where the wooden interior had not dried out. Fan blades on two of the fans were destroyed and several motors were damaged. Firemen used four 2½-inch hose streams to extinguish the fire. It is believed that the fire originated on the wooden top of the tower and was caused by a carelessly discarded cigarette. As a result of the fire the rotogravure department was shut down for several hours until the undamaged sections of the tower could be put back in service.

Two wooden forced draft cooling towers located about five feet apart on the roof of an industrial plant in a mid-western city were destroyed by fire in 1955. Employees were prepar-

May 10, 1956, Arlington, Va. — A spark from a nearby incinerator chimney is believed to have lodged in and ignited this wooden induced draft cooling tower. The tower had been shut down since October.



Particular fire safety precautions should be taken when a tower is shut down for repairs. This forced draft tower was probably ignited by a torch used in the tower to prepare tar to be mopped on the catch basin.

ing the towers for operation and were using torches to heat tar to mop on the catch basin. The employees left the towers at 2:15 P.M. to go to lunch and at 2:35 other employees detected fire in one of the towers. Members of the plant fire brigade unsuccessfully tried to extinguish the fire with first aid extinguishers and a hose line and at about 2:50 P.M. the city fire department was called. Fire spread to the adjacent tower and before extinguishment was completed both towers were destroyed. Considerable delay ensued before hose lines were placed in operation until power was shut off at high voltage

lines near the towers. It was determined that the torches had been used inside the towers without plant fire department authorization.

Welding on a cooling tower with a wooden interior is an extremely hazardous operation as illustrated by this fire on March 16, 1954 involving a cooling tower on the roof of a department store in New York City. The induced draft tower was on a concrete basin about six feet above the roof of the building and was 22 ft. by 22 ft. by 29 ft. with redwood interior and sheet metal exterior covering. The tower had been shut down for about two months for maintenance repairs. The interior had been freshly tarred. A welder was making a patch in the roof of the tower when a spark apparently dropped into the tower and ignited the interior. Although a fire watch had been maintained with the welder, they had finished their work and left the structure 15 or 20 minutes before the fire broke out. The entire interior was destroyed before adequate hose streams could be put into play and the shell structure was also a total loss. Since the tower was set up on concrete pilings, there was no damage to the roof of the building.

An ignition source not indicated in this record but reported by some fire protection agencies as having caused fires in water cooling towers, is lightning. Obviously a cooling tower on the roof of a building would be particularly vulnerable to lightning and should be protected in accordance with the provisions of NFPA No. 78, Code for Protection Against Lightning.

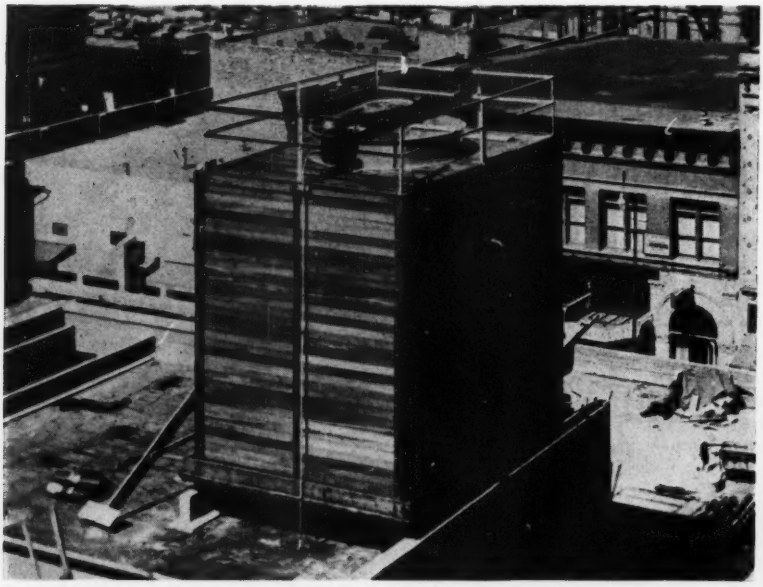
In many of these representative examples of fires in water cooling towers, the damage to the cooling tower resulted in a loss in production. The total loss in eight of these nine cases (in one case the loss was not reported) was about $308,000. When equipment involves losses of this magnitude and the production of a plant may hinge upon the continued operation of a cooling tower it becomes an obligation to all concerned to be sure that the tower has maximum fire protection.

Protecting Water Cooling Towers

An automatic sprinkler system is the best protection for combustible cooling towers. A dry pipe or deluge system is generally recommended interlocked with the fans, if any, to shut them off if the system operates. It may be argued that a cooling tower normally entirely wet during operation does not require protection of this type and in some conditions of use, location and design, the requirements of sprinkler protection might be waived. But even atmospheric and forced draft towers that are almost completely wet during operation require protection when they are shut down for any reason or where, as in large installations, there are several towers in a bank and only a portion of the towers are operated at one time because of the load demand. Sprinkler protection for induced draft towers should generally be mandatory because even during operation, the portion of the tower (about three feet) above the water distribution heads is never wet.

Towers with enclosed combustible sides such as the induced and forced draft types, should be located far enough away from chimneys, stacks, incinerators and other sources of sparks so as to overcome the possibility of the tower becoming ignited. A noncombustible sheathing can be installed on the sides of the tower to minimize the chance of a spark lodging in the tower. The roofs of induced draft towers may be covered with noncombustible material and the fan opening protected by a ¼-inch mesh screening to prevent sparks from dropping through these openings when the tower is shut down. This type of protection might allow the tower to be located nearer potential spark hazards than would be recommended for an unprotected wooden tower.

The matter of exposure in this case works both ways because it would not



The Marley Company

This photograph shows a typical induced draft wood cooling tower on the roof of a building. Note that the pipe to the water distribution system is considerably below the top of the tower.

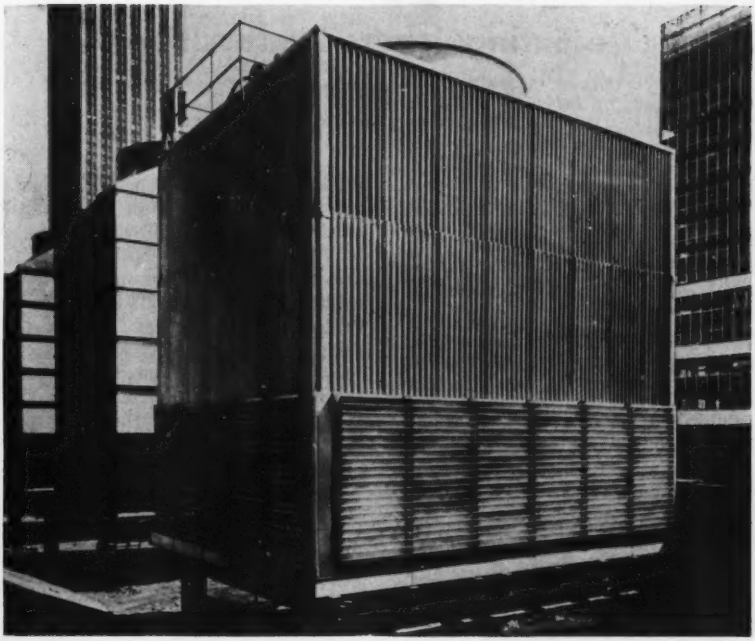
be advisable to place a tower where it, if involved in fire, might cause damage to an adjacent structure. This is particularly true of a tower located on the roof of a building. Towers on roofs should have noncombustible catch basins and the entire tower should be noncombustible if towers are not readily accessible for fire fighting.

In situations where it is necessary to locate a combustible cooling tower on the roof of a building it is desirable to have accessibility to a standpipe hose from a stairtower or a roof hydrant. The hose should of course be long enough to reach all parts of the tower. In the case cited previously in Arlington, Va., on May 10,1956,for example, the standpipe was available but there was no hose attached and there was considerable delay until firemen could carry hose to the roof of the 13-story building.

Particularly obvious in the photograph of the fire on page 100, is the desirability of easy access to the top of the tower not only for fire fighting but also for inspection and maintenance. A substantial stairway or ladder to the top of the tower and a guardrail around the top is recommended for this purpose.

Fire Prevention Ideas

Another point of discussion involving exposure, is the problem of grass and weeds and the fencing of areas where towers are located in mill yards. A tower would certainly be as susceptible to exposure from grass fires as any other type of structure and therefore grass and weeds should be kept clear from the area around a tower. Similarly, trespassers should be barred from areas in which towers are located by suitably enclosing the area with a heavy woven wire or equivalent fence.



The Marley Company

This completely noncombustible cooling tower has a steel structure and a casing and louvres of asbestos cement board and is installed on the roof of large department store building. As cited in this article, a wood cooling tower was destroyed by fire on March 16, 1954 on the roof of the same building in New York City.

Electrical wiring and motors are a potential fire source and, as with any apparatus, the electrical installation should be in accordance with the provisions of NFPA No. 70, National Electrical Code. Since motors are exposed to the weather, they should be of the totally enclosed type and equipped with suitable overload protective devices. The motors and their wiring must also be located where they are easily accessible for inspection and servicing.

Good maintenance is good economy and a good fire prevention measure. Where towers are operating continuously they should be inspected at least twice a day for excessive heating in motors, speed reducers or at fan bearings. About twice a year, depending on the use of the tower, the fan assembly including motors should be disassembled and checked for excessive wear, fatigue, improper lubrication and other features that could result in failure. Wooden towers that are shut down become very dry and are particularly susceptible to ignition from the hazards usual to maintenance such as welding and cutting or from sparks from other sources. During these periods, towers that are not protected by automatic extinguishing methods should be protected by special provisions for watchman service and manual extinguishing equipment until the tower is back in service.

Conclusion

Combustible cooling towers will burn. Their loss by fire may cause serious production loss, so let's recognize the problem and protect them.

Fire Extinguishers Reclassified!

By J. A. Bono, Member

NFPA Committee on First Aid Fire Appliances

For over 30 years the NFPA Standard on First Aid Fire Appliances (NFPA No. 10) has used the same method for classifying fire extinguishers. This system has now been replaced by a new scheme designed:

1. To eliminate the inequities of the old classification system;
2. To encourage better design of extinguishers;
3. To promote the development of new agents having increased extinguishing potential;
4. To develop a way to classify wheeled extinguishers so that their potential could be properly determined;
5. To include recommendations for the installation of extinguishers for the protection of specific hazards.

The 1956 printing of NFPA No. 10 reflects these revolutionary changes.* This article is designed to highlight the changes and the reasons for them.

Background

The old, or previous, method of classification was developed over thirty years ago to evaluate specific types of extinguishers, primarily those of the vaporizing liquid and foam types. Since its original development, new types of extinguishers have been designed including those employing carbon dioxide, dry chemical and wetting agents. These types were evaluated using the old method of classification although it was noted that the extinguishing potentials of these newer type extinguishers were frequently much better than those of the older type devices. In fact, there were extinguishers which under the old method of evaluation had identical classifications although tests showed that their extinguishing potential differed by as much as 800 per cent. In other words, the classification system originally developed had established a maximum rating beyond which it was impossible to classify any better performance and this tended to reduce the incentive to improve the design of devices or to encourage the development of new extinguishing media with greater potential.

There were several other factors which entered into the picture encouraging the development of a new classification system. Among them were the following: (1) the old system provided no means of evaluating wheeled extinguishers since the largest standard fire test used was far short of the extinguishing capacity of wheeled devices; (2) the existing standard gave inadequate guidance on the ability of extinguishers to handle specific hazards and made few recommendations on the proper way of assigning particular type extinguishers to meet any specific hazard; and (3) the previous classification scheme placed considerable emphasis on the capacity of the extinguishers and it was generally assumed that, for instance, a 15 pound capacity device would provide better protection than a 10 pound capacity device regardless of the agent used or the design of the extinguisher.

The drafting of this new classification system was done in a typical democratic way, spearheaded under NFPA guidance by the U. S. extinguisher industry and the Underwriters' Laboratories. In 1952 two alternate programs were prepared as a basis for consideration. In the 1953 NFPA Advance Re-

*Published in separate pamphlet form, June 1956 ($.50 a copy) and in National Fire Codes, Vol. IV, 1956.

ports a summary of these methods was reported to the entire NFPA membership and during the Committee meetings in 1954 and 1955 these original alternate methods were further considered. In May of 1955 the 1955 NFPA Advance Reports carried the plan essentially adopted at the 1956 NFPA Annual Meeting. In 1955, the report of the Committee was tentatively adopted with final action taken this year.

Behind the program was a very serious practical problem — the testing work required to draft the new ratings. Beginning in the summer of 1954 and continuing up to June 7, 1956 approximately 750 fire tests were conducted at Underwriters' Laboratories. In conducting these tests, some 30,000 gallons of gasoline were used and the flammable liquid test fires ranged in area from 2½ to 200 square feet utilizing in individual tests from 3 to 250 gallons of gasoline.

What the New System Does

The basic classes of fire remain the same for the purposes of classifying extinguishers. Thus the following definitions are given in the current issue of "Number 10":

Classification of Fires

221. For all practical purposes, there are three general classes of fires:

(a). Class "A" Fires, defined as fires in ordinary combustible materials such as wood, cloth and paper where the "quenching-cooling" effect of quantities of water or solutions containing large percentages of water is most effective in reducing the temperature of the burning material below the ignition temperature and is, therefore, of first importance.

(b). Class "B" Fires, defined as fires in flammable petroleum products or other flammable liquids, greases, etc., where the "blanketing-smothering" effect of oxygen-excluding media is most effective.

(c). Class "C" Fires, defined as fires involving electrical equipment where the electrical nonconductivity of the extinguishing media is of first importance.

The principal change comes in the method of determining the extinguishing potential of a device. The 1956 Edition of "Number 10" reads as follows:

Classification of Fire Extinguishers

231. Based upon the preceding classification of fires and also upon fire extinguishment potentials as determined by physical testing of fire extinguishers by Underwriters' Laboratories, Inc., classifications have been established for first aid fire extinguishing appliances.

232. This classification consists of a NUMERAL and a LETTER. It appears on the label affixed to the appliances labeled by Underwriters' Laboratories, Inc., and Underwriters' Laboratories of Canada. This NUMERAL and LETTER connote the following:

(a). In the case of Class "A" appliances, the NUMERAL is indicative of the approximate relative fire extinguishing potential of various size Class "A" fire appliances, i.e., a 4-A appliance can be expected to extinguish approximately twice as much fire as a 2-A appliance.

(b). In the case of Class "B" appliances, the NUMERAL is also indicative of the approximate relative fire extinguishing potential of various size Class "B" fire appliances, and in addition, the NUMERAL is an approximate indication of the square-foot area of deep-layer flammable liquid fire which an average operator can extinguish, i.e., a 10-B unit can be expected to extinguish 10 square feet of deep layer flammable liquid fire when used by an average operator.

(c). In the case of Class "C" appliances, no NUMERAL is used since Class "C" fires are essentially either Class "A" or "B" fires involving energized electrical wiring and equipment. The size of the Class "C" appliance installed should be commensurate with the size and extent of the area involving the electrical hazard or containing equipment being protected,

considering that it must be covered or blanketed by the Class "C" extinguishing media for effective fire extinguishment.

(d). The LETTER refers to the class of fire (see Paragraph 221 preceding) on which the use of the particular appliance is approved for most effective fire extinguishment.

Example applications of the new numeral and letter system are given:

Foam extinguisher, rated 2-A,4-B. This appliance should extinguish approximately twice as much Class "A" fire as a 1-A appliance, and four times as much Class "B" fire as a 1-B appliance. Also, the extinguisher should extinguish a fire in a deep-layer flammable liquid, such as a dip tank having a surface area of 4 square feet, when used by an average operator.

Dry chemical extinguisher, rated 6-B,C. This appliance should extinguish approximately six times as much Class "B" fire as a 1-B unit and should successfully extinguish a deep-layer flammable liquid fire of 6 square foot area when used by an average operator. It also is safe to use on fires involving electrical equipment.

When it comes to the distribution of extinguishers, new Section 3 of "Number 10" gives the following guidance:

311. The required number of extinguishers may be obtained by providing devices of any of the types described in these Standards, or a combination of two or more types, selected in accordance with the character of the fires anticipated, and their suitability for the individual property protected.

312. The number of first aid fire extinguishers to be installed shall be determined by the authority having jurisdiction in accordance with the severity of the incipient fire anticipated, i.e., rapidity with which a fire may spread, the intensity of the heat that may be developed and the accessibility of the fire. Where there are special hazards in addition to the ordinary hazards of the occupancy, additional and/or substitute units of suitable type shall be installed for the protection of such hazards (see Paragraphs 314 and 318).

313. The number and type of extinguishing units required shall be determined as specified in Paragraphs 314-321. The term unit refers to the numerical extinguishing capacity for any given fire classification as shown on the label affixed to the extinguisher, i.e., an extinguisher having a classification of 2-A, 4-B, is regarded as possessing 2 units of extinguishing capacity for Class A fires and 4 units of extinguishing capacity for Class B fires. This can be translated into terms of actual extinguishers based on the classification and the numerical unit value of the extinguisher to be used.

For example, if 8 units are required for Class "A" protection and soda-acid extinguishers are to be provided having 2-A classification on the label, four extinguishers will be necessary.

Similarly, if 8 units are required for Class "B" protection and dry chemical extinguishers are to be provided having 4-B classification, two extinguishers will be acceptable for area protection, but individual hazards shall be protected by single extinguishers as recommended in Paragraph 318. (c).

314. General. Requirements as outlined in Paragraphs 315, 316 and 317 are based strictly on the provision of Class "A" extinguishers. Supplemental Class "B" and/or Class "C" extinguishers shall be provided where blanketing or nonconducting extinguishing agents are necessary.

315. Class I Light Hazard Occupancies, so classified by the authority having jurisdiction, where because of a relatively small amount of combustibles, incipient fires of minimum severity may be anticipated. Class "A" extinguishers shall be provided throughout, so located that a person will not have to travel more than 100 feet from any point to reach the nearest device but at least one unit of extinguishing capacity shall be required for every 2500 square feet of floor area or greater fraction thereof on each floor.

NOTE: This class may include occupancies such as office buildings, schools (exclusive of trade schools and shops), public buildings, etc. Limited areas within such buildings containing ordinary hazard occupancies shall be protected as required under Class II.

316. Class II Ordinary Hazard Occupancies, where incipient fires of average severity in combustibles may be anticipated. Class

"A" extinguishers shall be provided throughout, so located that a person will not have to travel more than 50 feet from any point to reach the nearest device, but at least one unit of extinguishing capacity shall be required for every 1250 square feet of floor area or greater fraction thereof on each floor.

NOTE: This class may include occupancies such as department stores, warehouses and manufacturing buildings of average hazard.

317. Class III Extra Hazard Occupancies, where because of the character or quantity of combustibles, extra severe incipient fires may be anticipated. Class "A" extinguishers shall be provided throughout as specified for ordinary occupancies with additional Class "B" and/or Class "C" extinguishers to be provided at the discretion of the authority having jurisdiction.

NOTE: This class may include occupancies such as woodworking, spray painting, dipping, etc.

318. Special Provisions Relating to Class "B" Extinguishers.

(a). Exceptional cases may develop wherein the total area under consideration will present wholly Class "B" hazards in which case Class "B" extinguishers may be acceptable, protecting the entire area on a basis of one numerical extinguishing unit for every 625 square feet or greater fraction thereof of floor area. Travel distance shall not exceed 50 feet from any point to reach the nearest device.

(b). Class "B" extinguishers, except as noted in Paragraph 318 a., shall be required in addition to the Class "A" requirement where blanketing effect is essential; to be provided on the basis of one unit of extinguishing capacity for every 625 square feet or greater fraction thereof of such hazardous floor area to be protected. In establishing such area, consideration shall be given to providing protection for spill fires or surface fires involving flammable liquids.

(c). For deep-layer flammable-liquid fires, as in dip or quench tanks or similar individual hazards, at least one Class "B" type extinguisher shall be provided on the basis of one numerical unit of extinguishing potential per square foot of the largest individual hazard to be protected. Multiple smaller extinguishers shall not be employed in lieu of the larger extinguisher. When approved automatic protection is provided for deep-layer flammable-liquid hazard, this latter requirement may be waived.

(d). Class "B" extinguishers, except as noted in Paragraph 318 a., b., and c., are not acceptable in lieu of required Class "A" extinguishers unless the device selected also has a Class "A" rating. Otherwise, Class "A" extinguishers shall be required in the same area protected by Class "B" units, the former to be installed on the basis of one numerical unit for 5,000 square feet in Light Hazard Occupancies or 2,500 square feet in Ordinary or Extra Hazard Occupancies.

EDITORS NOTE: Where the hazard is primarily Class B with some Class A fire possible, the extinguishers provided for the Class A hazard on a square-footage basis need be only one-half that ordinarily provided under Paragraphs 315 and 316, providing, further, that the Class B units are installed in accordance with 318. (b).

(e). An extinguisher carrying two or more letters and numerical unit designations may be accepted for area requirements under each individual letter classification and at the numerical rating for that class, i.e., one foam extinguisher (2-A,4-B) may be acceptable for 2 times 1,250 square feet (2500 square feet) of ordinary combustible areas and also for 4 times 625 square feet (2500 square feet) of area requiring blanketing protection.

319. Extinguishers with "C" classification shall be required where nonconducting extinguishing media agent is of first importance. Distribution shall be in accordance with applicable provisions of Class "B" extinguishers.

320. Travel distance should be given consideration with reference to special hazards and the extinguisher selected for such protection. Scattered or widely separated

hazards should be individually protected if the above specified travel distance to the required type of extinguisher is exceeded. Likewise, extinguishers in the proximity of a hazard shall be carefully located so as to be accessible in the presence of a fire without undue danger to the operator.

Paragraph 321 advises readers of "Number 10" to refer to a Conversion Table (printed in the Appendix to the Standard) to determine the current equivalents of extinguishers showing the old classification symbols. This Conversion Table is reprinted here. Note that the new classifications are "approximate." Actual tests must be conducted on *each* type extinguisher as produced by *each* manufacturer to develop a precise classification for *each* particular device.

Approximate Conversion Table on Classification of Fire Extinguishers

The method of classifying extinguishers used in the 1955 and earlier Editions of NFPA No. 10 differs from the presently described method. The object of this Table is to indicate an *approximate* conversion from the old to the new method of classifying first aid fire appliances. Since an accurate reclassification of extinguishers already in service and labeled under the old system of classification cannot be determined except by actual fire tests, only *approximate* conversion classifications can be given.

CLASSIFICATION OF FIRE EXTINGUISHERS

Extinguisher Type and Size		Classifications Under Old Method	Approximate Classifications Under Present Method
Chemical Solution (soda-acid)	1¼, 1½-gallon	A-2	1-A
	2½-gallon	A-1	2-A
	17-gallon	A	10-A
	33-gallon	A	20-A
Water	1½, 1¾-gallon (pump or pressure)	A-2	1-A
	2½-gallon (pump or pressure)	A-1	2-A
	4-gallon (pump or pressure)	A-1	3-A
	5-gallon (pump or pressure)	A-1	4-A
	17-gallon (pressure)	A	10-A
	33-gallon (pressure)	A	20-A
	6 10-quart pails and 25-gallon cask (minimum)	A-1	2-A
Loaded Stream	1-gallon	A-2,B-4	1-A
	1¾-gallon	A-1,B-2	2-A,½-B
	2½-gallon	A-1,B-2	2-A,½-B
	33-gallon	A	20-A
Foam	1¼-gallon	A-2,B-2	1-A,2-B
	1½-gallon	A-2,B-2	1-A,2-B
	2½-gallon	A-1,B-1	2-A,4-B
	5-gallon	A-1,B-1	4-A,6-B
	10-gallon	A,B	6-A,8-B
	17-gallon	A,B	10-A,10-B
	33-gallon	A,B	20-A,20-B
Vaporizing Liquid (carbon tetrachloride base)	1, 1¼, 1½-quart (pump)	B-2,C-2	½-B,C
	1, 1½, 2, 2½-quart (pressure)	B-2,C-2	½-B,C
	1-gallon (pressure)	B-2,C-1	1-B,C
	3½-gallon (pressure)	B-2,C-1	1-B,C
Vaporizing Liquid (chlorobromomethane)	1 and 1½-quart (pressure)	B-2,C-1	1-B,C
	1-gallon (pressure)	B-2,C-1	2-B,C

CLASSIFICATION OF FIRE EXTINGUISHERS (CONT.)

Extinguisher Type and Size		Classifications Under Old Method	Approximate Classifications Under Present Method
Carbon Dioxide	6 or less pounds of carbon dioxide	B-2,C-2	1-B,C
	7½ pounds of carbon dioxide	B-2,C-1	2-B,C
	10 pounds of carbon dioxide	B-2,C-1	4-B,C
	12 pounds of carbon dioxide	B-2,C-1	4-B,C
	15 and 18 pounds of carbon dioxide	B-1,C-1	4-B,C
	20 pounds of carbon dioxide	B-1,C-1	4-B,C
	25 and 26 pounds of carbon dioxide	B-1,C-1	6-B,C
	50 pounds of carbon dioxide	B-1,C-1	10-B,C
	75 pounds of carbon dioxide	B-1,C-1	12-B,C
	100 pounds of carbon dioxide	B,C	12-B,C
NOTE: Carbon dioxide extinguishers with metallic horns will not carry any C classification.			
Dry Chemical	6¼ or less pounds of dry chemical	B-2,C-2	4-B,C
	7½ pounds of dry chemical	B-2,C-1	6-B,C
	10 pounds of dry chemical	B-1,C-1	8-B,C
	12 pounds of dry chemical	B-1,C-1	8-B,C
	15 pounds of dry chemical	B-1,C-1	8-B,C
	20 pounds of dry chemical	B-1,C-1	16-B,C
	30 pounds of dry chemical	B-1,C-1	20-B,C
	75 pounds of dry chemical	B,C	40-B,C
	150 pounds of dry chemical	B,C	40-B,C
	300 and 350 pounds of dry chemical	B,C	40-B,C
Wetting Agent	10 gallons	A,B	6-A
	20 gallons	A,B	12-A
	50 gallons	A,B	30-A

Are Your Fire Laws Up-to-Date?

By Captain Carroll Shaw

Office of the State Fire Marshal, Connecticut State Police

There is an implication in the above title that the fire laws of the State of Connecticut are modern, up-to-date, and approach the peak of perfection. I certainly do not wish to give this impression. In fact, I hope that the day never comes when any fire marshal is content to rest on his laurels, convinced that the laws under which he works — and his methods of enforcing those laws — cannot be improved upon.

It might be interesting, however, to report on what has been done in Connecticut to get into the statute books laws which, although not the whole answer to the problem, nevertheless go a long way in the direction of the ultimate objective — full protection for the public against the hazards of fire, smoke and panic in places of public assembly and commercial establishments.

If the Connecticut fire laws are a little more up-to-date than the laws of some other states, the big reason is not because of any great foresight on the part of the Office of the State Fire Marshal, but, rather because of a series of circumstances — unfortunate circumstances — that had the effect of forcing our hand.

Based on an address presented by the author at the Fire Marshals Section meeting held in conjunction with the 60th NFPA Annual Meeting in Boston, Mass., June 4-8, 1956.

On July 6, 1944, 168 lives were lost in Hartford.* The "Big Top" of Ringling Brothers Barnum and Bailey Circus became a raging inferno. The ordinary waterproof cotton canvas burned so rapidly that nothing in the world could stop it. On Christmas Eve the following year in Hartford the lives of 19 aged persons were lost in a fire that destroyed a nursing home — the result of a short circuit in Christmas tree lighting.† Needless to say, both disasters could have been prevented if there had been adequate regulations in effect at the time, and if these laws had been rigidly enforced — but — and this is very important — both tragedies occurred despite the fact that every applicable ordinance of the City of Hartford and every applicable law of the State of Connecticut had been complied with fully — and there were not many people in the State who, prior to these disasters, were not completely convinced that the fire laws of Connecticut were as modern and up-to-date as intelligent men could make them.

As a result of these tragedies, the public demanded that ways and means be found at once to prevent any such holocausts in the future. The Governor appointed a Study Committee made up of Fire Chiefs, Fire Marshals, fire protection engineers, and prominent citizens interested in the problem. Under this pressure, the Commissioner of State Police — as State Fire Marshal — and his staff devoted their full time and energies to this problem.

Background

It might be desirable to digress briefly to explain that in Connecticut, the Commissioner of State Police is also the State Fire Marshal. The Connecticut State Police Department is the oldest organization of its kind in the country, having been organized by an act of the Legislature in January 1903.

*See July 1944 Quarterly, Page 9.

†See January 1946 Quarterly, Page 242.

When the Legislature next convened in 1905, public recognition was given the new department for its splendid achievements and, among other changes, the Commissioner of State Police was then named State Fire Marshal. This arrangement is still effective, 52 years later. The theory was then, as it is now, that the enforcement of laws pertaining to fire safety is not greatly different from the enforcement of laws relating to robbery, theft, rape or murder. Any person who because of his negligence or by his acts of omission, or commission, is responsible for the death of a human being by fire is no less a criminal than the person who murders another with a knife, gun, or other weapon.

To get back to that period after our two disastrous fires, the Commissioner and his staff, wrestling with the problem of providing legal safeguards for the public against the hazards of fire, came up with an idea that has made history in the field of fire protection. There were fire laws on the statute books of Connecticut as there were on the law books of every state in the union. They covered such things as fire escapes and exits but did not go much beyond these elementary features. It was felt at first that these existing laws should be changed, amended or enlarged so as to cover the whole field of fire safety. It was recognized, however, that there were disadvantages in following such a course of action. First of all, it takes an awful lot of doing to get legislation passed. There are numerous hearings before many legislative committees, action by both the House and the Senate, and the signature of the Governor before the bill becomes law. To make any necessary changes would require going through the same procedure every two years.

We knew also, from experience, that whatever occupancy was regulated there would be pressure groups ready to meet us head-on in opposition to what would be considered interference in their af-

fairs and encroachment on the system of free enterprise. Everybody is for public safety and for regulations against fire hazards as long as it is the other fellow who is regulated. We felt that if we attempted to "spell out" in the statutes every detail of the requirements, before the bill was ready for action, changes and substitutions would make the document hardly worth the paper on which it was written. It was then decided to go before the Legislature, and in brief and simple language just ask for authority to write fire safety regulations — to secure an Enabling Act. We were advised not to be too optimistic about this approach — that any such Enabling Act might be considered an unlawful delegation of power since the law-making power was in the legislative branch of the government and could not be constitutionally delegated to the executive branch. Nevertheless, and taking into consideration, I am sure, the unassailable integrity of the Department for 50 years, and its present Commissioner, Colonel John C. Kelly, a distinguished member of the Department for more than 35 years, the legislature passed the Enabling Act with hardly a dissenting vote. The Act read simply:

> "The state fire marshal shall establish a fire safety code and at any time may amend the same. The regulations in said Code shall provide for reasonable safety from fire, smoke and panic therefrom, in all buildings except in private dwellings occupied by one or two families, and upon all premises except those used for manufacturing."

A following section provided that it was not to be implied that the rights of municipalities to write their own fire laws were to be impaired provided that the local regulations were at least as rigid as those of the Connecticut State Fire Safety Code.

Private dwellings were exempted as we knew from experience how much trouble you can get into when you try to regulate a man's home. Under the Constitution a man's home is his castle, and we are very much aware of this. You will note, also, that we exempted factories from the requirements. This was done because the State Labor Department had for many years been doing a magnificent job in requiring protective measures for the working man. We were careful not to take the prerogative away from the towns because in Connecticut as in most other states in this country, the doctrine of home rule is strongly held; and so we said that local ordinances could provide for fire safety as long as these requirements were equally as rigid as the State laws. As a practical thing, however, there is no town or city in Connecticut which does not use the State Fire Safety Code as the "Bible." It was used in the City of New Haven by Gene Mulligan, dean of Connecticut Fire Marshals, as a basis for action against a hotel owner. The defendant made an appeal to the high court attacking the constitutionality of the Code. It goes without saying that we were very much concerned over this appeal because so very much depended on it. To our great satisfaction the constitutionality of the Code was upheld by the Connecticut Supreme Court of Errors which commented:

> "While the law-making power is in the legislative branch of the government and cannot constitutionally be delegated, the General Assembly may provide for the carrying out of a legislative policy within the police power of the State by delegating to an administrative agency the power to fill in the details. A proper regard for the very limited authority of the Judicial Department to interfere with the legislative determination of the matters affecting the welfare of citizens of this state requires that every presumption and intendment be made in favor of the validity of an act of the Legislature, and that it be sustained unless its invalidity is beyond a reasonable doubt."

Judging from the volume of mail received, the impact of this ruling on the public was tremendous. It meant that we had been given the "go-ahead" signal to write fire safety regulations covering the entire field. To date the Code covers new schools, existing school buildings, convalescent homes, hospitals, boarding homes for the aged, places of public assembly, hotels, rooming houses and child day care centers. It would not be accurate for me to say that we never have trouble with the Code because we do. Pressure groups die hard, but little by little the tasks get easier. The Code is now accepted as a good law — an unselfish law — written with consideration for no interests other than the public interests— for the protection of every man, woman and child in the State.

NFPA Services Cited

But, as we look back now, we realize we made mistakes too — the most serious of which was failing to recognize the fact that available to all are the services of the National Fire Protection Association. If we had taken advantage of NFPA services in writing the Code originally we would have saved ourselves months of frustrating effort looking for the answers to many problems. Why the assistance of the NFPA was not originally solicited I have no way of knowing. Perhaps it was because of jealousy, or probably because of a suspicion that the NFPA had an axe to grind, but when the next opportunity presented itself, we did not make the same mistake.

When the last session of the Connecticut legislature empowered the Commissioner of State Police to make regulations on the storage, transportation and use of liquefied petroleum gas and to amend regulations on the storage, transportation and use of flammable liquids, the first thing we did at the suggestion of Chief Henry Thomas of Hartford, was to get in touch with Mr. Percy Bugbee, General Manager of the NFPA. We told him we had been successful in getting through an Enabling Act that included the words:

> "In adopting such regulations said Commissioner may be guided by recognized national standards."

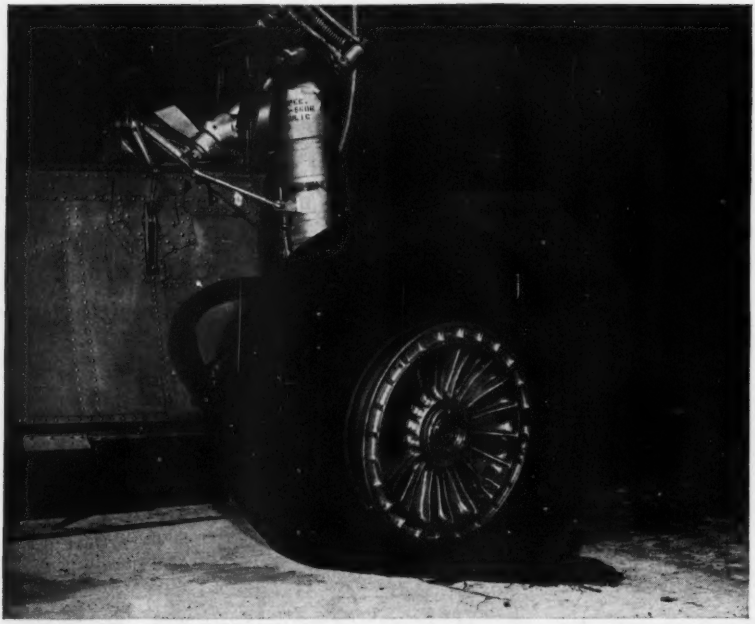
As far as we were concerned, these were the standards of the National Fire Protection Association. Mr. Bugbee assigned Miles E. Woodworth and Clark F. Jones, NFPA Flammable Liquid and Gases Field Engineers to assist the State as a result of a subsequent official request. Their contributions were so extensive it is hard to express adequately our appreciation. At all our conferences and work sessions at State Police Headquarters at Hartford, Mr. Woodworth and Mr. Jones were our good "right arms." They had the technical knowledge that we lacked. They supported, every minute, not industry, not the State Police Department, but the NFPA program ". . . to promote the science and to improve the methods of fire protection and prevention, to obtain and circulate information on these subjects, and to secure the cooperation of its members and the public in establishing proper safeguards against loss of life and property by fire." They never compromised this position. They resolved to the satisfaction of all every kind of dispute. They held no brief for anybody who was arbitrary or unreasonable, and were very frank to tell us when they thought we were being unreasonable in our demands. As a result, the finished documents had the endorsement of the entire committee — industry, fire chiefs, fire marshals, engineers, police and the public.

This service did not cost the State one cent. Connecticut is sold on NFPA and we are putting in a bid right now for the services of the organization as we go into revisions of the Code concerning regulations covering the storage, transportation and use of explosives, regulations covering dry cleaning establishments, motion picture theaters, places of assembly under canvas, and the installation of oil burners.

Aircraft Landing Gear Fires

A rash of aircraft landing gear fires has caused considerable concern, not only to those interested in prevention but also those concerned with extinguishment techniques. Solutions are not immediately apparent but this article reports four incidents, each different in some details, to indicate the scope of the problems presented. As in many case histories of fires, some information is lacking on the fires reported but unusual efforts have been expended

Photo No. 1. Fire in the landing gear was carried aloft in a tanker plane and is blamed for this crash in a pine forest. The accident was fatal to all six crewmen aboard.



Official U. S. Air Force Photo

Photo No. 2. The tire ignited from a brake lining fire. The subsequent tire blowout slightly injured one man.

in collating this data. Dates, names and places of the accidents are intentionally omitted.

Case No. 1

The least information is known about this tragedy. An airborne refueler (tanker) plane crashed in a dense pine forest (see Photo No. 1) soon after take-off. The accident site was 65 miles from the nearest airport and thus was not accessible to aircraft rescue and fire fighting crews who normally would have responded.

Reconstruction of the accident is difficult because of the extent of the crash and fire damages. The investigation indicates, however, that the fire originated in the wheel assembly because of overheating during taxiing and holding operations prior to take-off. The fire is assumed to have started in the brake lining or to have been caused by hydraulic fluid seepage. It is probable that the magnesium wheel or the tire ignited and the fire spread from the wheel well (following retraction of the gear) to the right wing. Wing separation occurred about 18 minutes after take-off and is presumed to have resulted from fire damages. Six fliers died in the tragic accident.

Case No. 2

Fire, which originated in the brake lining during landing and taxiing operations, was noticed by a crew member of a bomber type aircraft as the plane was parked on the ramp.

The fire was first attacked with a carbon dioxide hand extinguisher available to the crew member. While the crew member was standing between the bomb bay and the wheel well doors, the

tire exploded, apparently as the result of the fire exposure. (Tire pressures at the time were 100 pounds per square inch.) The crew member received minor injuries as a result of the tire failure. Photo No. 2 shows the extent of the fire damage to the tire following extinguishment with water fog.

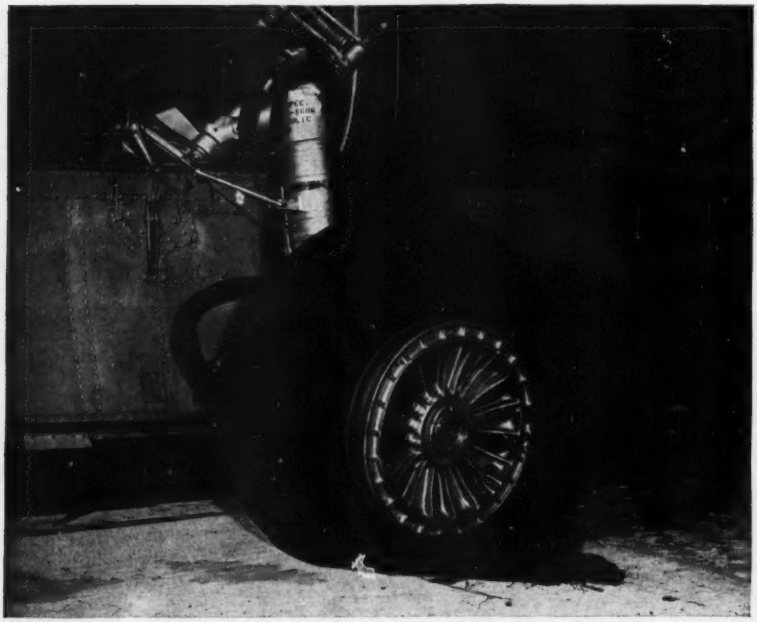
In this accident only the brake lining and rubber tire burned. Neither the magnesium wheel nor brake hydraulic fluid was involved. The brake lining ignition was apparently the result of overheating brakes following a number of test take-off and landing operations. The use of carbon dioxide in this case did not seem to have any direct connection with the subsequent tire explosion (see, however, Case No. 4). The aircraft was splattered with burning rubber particles.

Case No. 3

During another landing gear fire a wheel exploded. An officer was fatally injured by flying fragments of the wheel which struck him while he was standing some 60 feet from the parked aircraft. The aircraft involved, another bomber, had completed a flight test mission when a fire fighter noticed that the right landing gear was blazing as the plane was being parked. The fire was attacked immediately with carbon dioxide followed by water spray. Seven crash trucks were brought to the accident site but the fire fighters in the area had the fire under control by the time they arrived. After the fire had been apparently put out, no extinguishing agent was applied to the wheel for approximately six minutes, at which time reignition occurred, followed by an immediate explosion. Investigation has shown that the actual material burning was, in this case, a combination of hydraulic fluid and the magnesium alloy of the wheel. In the opinion of the officials investigating the accident, the explosion was caused by a breakdown of the

Official U. S. Air Force Photo

Photo No. 3. A combination hydraulic fluid and magnesium wheel fire caused the wheel to fail. One fragment struck and killed a man 60 feet from the parked aircraft.



Official U. S. Air Force Photo

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Photo No. 4. The 95 pound segment of the DC-7 wheel which was projected over 600 feet following the magnesium wheel failure.

magnesium wheel after the fire exposure and because of the stresses imposed on the wheel by the heat. When the wheel shattered the tire naturally blew out but the tire did not show any prior signs of failure or weakness. The crash crew subsequently extinguished the landing gear fire with carbon dioxide from the Type 0-6 crash truck available and with foam from other USAF crash fire trucks.

This accident is different from the others reported in Cases Nos. 1 and 2 in that hydraulic fluid was ignited and there was a material failure in the wheel itself. The fact that some of the magnesium was ignited was also of interest although this is also suspected in the airborne fire reported in Case No. 1. Photo No. 3 shows the wheel and strut remaining after the landing gear fire was extinguished for the second time. The notable thing about the wheel failure in this case is that the failure did not occur during the application of the cooling extinguishing agents (carbon dioxide and water fog) while in Case No. 4 the wheel exploded while the carbon dioxide was being applied.

Case No. 4

A commercial airline DC-7 returned to the ramp at a western airport following a false engine fire warning received while the aircraft was on its take-off run. It was subsequently learned that the false warning was caused by a defective sensing element in the engine fire detection system. As the aircraft arrived back at the loading ramp some flames were observed, however, around the outside left main gear brake. The fire was attacked promptly using a 15-pound carbon dioxide extinguisher. Suddenly there was a loud noise and a major portion of the wheel blew the axle nut off, left the axle and sailed across the open finger type ramp. A 95-pound piece of the wheel (illustrated in Photo No. 4) came to rest in a car port about 600 feet from the parked aircraft.

The investigation showed that the wheel had failed circumferentially an inch or so from the inner flange. In this case it appears that the wheel heated up during the braking following the aborted take-off (ironically caused by a false fire warning in the engine). It is felt that hydraulic fluid seeped past the seals and was ignited by the hot metal around the brake. In this case no magnesium was ignited and the failure of the wheel is attributed to the sudden chilling with carbon dioxide. At the time of the wheel failure, the tire blew out and this had some effect on the scattering of the pieces of the

wheel assembly in the vicinity of the aircraft. In Photo No. 5 the arrow points to a flange fragment.

It will be noted that this case then is different from all the others in that here hydraulic fluid was apparently the first material ignited and neither the brake bands, the magnesium wheel nor the rubber tires contributed to the intensity of the fire. Secondly, the material failure in the wheel occurred during the application of the cooling media rather than following the application as was true in Case No. 3. While the tire was shattered following the failure of the wheel itself, the tire was not itself responsible for the wheel failure.

Fire Control Methods

There does not seem to be any simple answer to fire control after the outbreak of a landing gear fire. Much depends on the circumstances — when the fire is discovered and what equipment is available for fire control efforts.

The airborne fire discussed in Case No. 1 shows the need of heat detectors in the wheel well and perhaps the only appropriate method of fire control in such a case is lowering the gear into the slip stream. Some research has been done in using air blasts as a fire control medium although this research contemplated attempts to control such fires while the aircraft was on the ground. In a propeller driven aircraft tests have shown that a wheel fire can *occasionally* be blown out by a strong blast of air where the prop is located directly ahead of the gear. Fires can be controlled so that they do no damage to the remainder of the aircraft by maintaining an air blast of approximately seventy miles per hour at the landing gear. If the tire is exposed to flame, however, for as little as two to five minutes a tire blowout should be expected.

In Case No. 2, where the principal material burning was the brake lining,

Photo No. 5. The arrow points to a flange fragment of the wheel that failed following a hydraulic fluid fire in the brake assembly.

water would obviously be the best control medium in that water would have the cooling and saturating effect desirable for this type of fire. It will be remembered that in this case the heat exposure caused the tire to fail and there was no metal failure even though carbon dioxide was used to cool and attempt extinguishment.

In Case No. 3 hydraulic fluid and magnesium were involved. This suggests the utilization of Class B extinguishers for the flammable liquid fire and one of the special magnesium powders for the wheel. There was a curious fact in this fire that no extinguishing agent was applied for six minutes prior to the explosion so that it isn't quite clear why the metal failed when it did or what caused the sudden reignition which preceded by seconds the explosion. Stresses imposed by the heating may have been building up or by conduction reached a weak point in the wheel during this time interval. It might be theorized that continued application of Class A and B media might have prevented the explosion in this case. In other phases of aircraft rescue and fire fighting the combined agent technique of using a quick smothering agent (carbon dioxide or dry chemical) and a final blanketing agent (foam) is standard procedure.

In Case No. 4 suspicion points rather strongly to the sudden cooling as having an influence on the wheel failure. Advices received from a leading technical authority in the magnesium field explain the phenomena in this way. A study of the conditions under which the failure took place indicates that extremely high superimposed stresses were applied to the metal which no metal could withstand. The expansion of the brake assembly during the brake application from take-off speed would produce severe stresses on the wheel casting and these stresses would be an internal pressure which would place tension stresses on the outer portion of the wheel. Such stress alone would not be expected to cause failure since the wheel and brake assemblies are designed for such an application. However, the subsequent application of the carbon dioxide extinguishing media (at a temperature of around 0° F.) would cool the magnesium wheel much more rapidly than the internal brake part. Apparently the combination of severe expansion from within and contraction from the outside provided the stresses which resulted in the wheel failure. It has been suggested that one way to avoid this problem would be to use dry chemical as the extinguishing media. This theory is based on the concept that dry chemical is a highly efficient extinguishing media for Class B fires and at the same time would have no chilling effect on the metal of the wheel. Magnesium is a metal that has a relatively high heat expansion (roughly twice as high as ferrous metals). As heating increases, strength decreases and a chill in a part of the casting might cause this part to shrink rapidly, which could be responsible for causing a fracture of the wheel. Another angle, that may explain the delayed failure of the wheel in Case No. 3, is that it might take some minutes for the heat of the wheel to cause a pressure increase in the tire. An increase of air pressure in the tire might in turn result in the failure of the wheel assembly. Since dry chemical will not chill as does carbon dioxide or water, the thought is that a more even contraction of the heated, expanded metal would occur and possibly prevent the shattering of the wheel assembly.

At any rate, no matter what fire extinguishing agents are used, the experiences reported in Cases Nos. 2, 3 and 4 indicate the desirability of attacking such wheel fires from a fore and aft position rather than from the side. The area on the side of the wheel in line with the axle should be kept clear of personnel as any pressure release will undoubtedly be most serious in that direction.

Meeting of Board of Directors

Boston, July 16, 1956

Present

Richard E. Vernor, Chairman
John A. Neale, President
Henry G. Thomas, Vice-President
Loren S. Bush, Vice-President
Allen L. Cobb, Past President
T. Seddon Duke, Past President
Hovey T. Freeman, Secretary-Treasurer

Warren J. Baker	J. Sharp Queener
Malcolm S. Blake	Elmer F. Reske
A. L. Brown	George J. Richardson
Charles H. Bunn, Jr.	Frank D. Ross
F. R. Fetherston	Leigh R. Sanford
A. Leslie Ham	Roger H. Wingate
Leonard Peterson	Udell C. Young

Percy Bugbee, General Manager; Robert S. Moulton, Technical Secretary; Horatio Bond, Chief Engineer; Charles S. Morgan, Assistant General Manager; George H. Tryon, Assistant Technical Secretary; Hylton R. Brown, member Technical Advisory Committee (former member of the Board); Merwin M. Brandon, Chairman, Electrical Section.

1. The following officers were elected in accordance with the recommendation of the Association by vote at the 1956 Annual Meeting: President — John A. Neale; Vice-President — Henry G. Thomas; Vice-President — Loren S. Bush; Secretary-Treasurer — Hovey T. Freeman; Chairman, Board of Directors — Richard E. Vernor.

2. The Advisory Committee for 1956-1957 was appointed as follows: President Neale, Vice-President Thomas, Vice-President Bush, Secretary-Treasurer Freeman, and Board Chairman Richard E. Vernor.

3. Messrs. Warren J. Baker and Elmer F. Reske were elected to the Nominating Committee for 1957. (This completes the personnel of the committee, other members of which include the two latest past presidents and those elected by the Association at the annual meeting.)

Annual Meeting Plans

4. Mr. Bugbee reported on plans for the 61st Annual Meeting, scheduled for the Hotel Statler, Los Angeles, May 20-24, 1957, and on tentative dates for future years as follows: 1958 — Chicago, May 19-23; 1959 — New York, May 18-22; 1960 — Montreal, May 16-20; 1961 — Detroit, May 15-19; 1962 — Philadelphia, May 14-18. These plans were approved as presented.

Mr. Bugbee reported an invitation from Honolulu to hold the 1963 Annual Meeting there. He indicated the enthusiasm of a large group of NFPA members in Hawaii and that this group had offered to cooperate in widespread promotion of the Honolulu meeting idea with the understanding that if the preliminary promotion did not indicate an attendance of at least 1,000 members at the meeting, any plans for a Honolulu convention might be canceled. This invitation was discussed, but no action was taken pending further developments.

5. The Program Committee for the 1957 Annual Meeting was appointed to include the President, the Chairman of the Board of Directors, Vice-President Loren S. Bush of San Francisco, and the General Manager.

Association's Finances

6. The report of the Treasurer, Mr. Hovey T. Freeman, was accepted. (Complete financial statement will appear in the 1956 NFPA Proceedings; a condensed statement appears in the June issue of *Fire News*.)

The ensuing discussion of Association finances reflected the great opportunities for additional service in the public interest on the part of the Association if the needed funds could be made available. Messrs. Queener and Cobb discussed the possibility of securing additional contributions from indus-

try, particularly from the chemical industry, and were optimistic that such contributions could be secured.

There was also discussion of the amount of NFPA dues and the staff was requested to review the entire subject and present to the next meeting of the Board detailed information and recommendations as to whether the Board should recommend to the 1957 Annual Meeting an increase in dues such as an increase from $12.50 to $15 for associate membership.

The discussion brought out two divergent points of view. One was that an increase to $15 would be generally acceptable and should produce a substantial increase in revenue without materially affecting NFPA membership. The other point of view expressed was that the Association could do a more effective job with a larger membership, that the dues should be kept as low as possible, and that the Association might be better off financially with a larger membership which would produce a greater circulation of NFPA publications, with consequent increased advertising income and an increased market for the sale of NFPA publications.

The General Manager was also requested to present to the Board at its next meeting a statement indicating the financial needs of the Association including needs for additional staff to do more effective work.

7. The Budget for 1956-1957 as submitted by the General Manager with the approval of the Finance Committee was amended and approved.

Society Almost 1,000 Strong

8. Mr. Reske reported as President of the Society of Fire Protection Engineers, indicating a present membership in the Society of approximately 1,000 members with a keen and growing interest particularly on the part of the local Chapter organizations. He reported that the increase in dues voted last year resulted in eliminating previous deficits and that the Society was now approximately $400 in the black.

Mr. Reske also made the suggestion that consideration be given to establishment of a new class of NFPA membership for students to be available for any interested student at $5 annual dues. This proposal was discussed and referred to a committee consisting of Mr. Duke, Mr. Baker and Mr. Reske.

NFPA Field Service Projects

9. Mr. Merwin M. Brandon, Chairman of the Electrical Section, reported on the activities of the Section stating that through the machinery of the Section a new edition of the National Electrical Code had just been completed for publication in September.

10 (a). Mr. Brandon reported on the Electrical Field Service, indicating general satisfaction with the services of the Electrical Field Engineer, Mr. Charles L. Smith. He also mentioned certain problems in securing contributions sufficient to maintain this project, expressing the hope that they could be met.

(b) Mr. Brandon also reported on the special project for editing the National Electrical Code, indicating the plan to prepare a revised, re-edited Code with change in language in the interest of clarity but with no change in intent, as soon as practical. In response to a question from Mr. Neale, Mr. Brandon stated that he did not expect any further new edition of the National Electrical Code for at least two years.

(c) Mr. Moulton reported on the Flammable Liquids and Gases Field Service projects, indicating the need for additional financial support to place these projects on a sound basis. Mr. Bunn, Chairman of the Flammable Liquids Field Service Committee, reported satisfaction with the operations of the project and with the work of the Flammable Liquids Field Engineer, Mr. Miles E. Woodworth. Mr. Fetherston, Chairman of the Gases Field Service Committee, made a similar report, in-

dicating satisfaction with the service rendered by the Gases Field Engineer, Mr. Clark F. Jones.

11. Mr. Bugbee reported on the successful development of Sparky's Fire Department for children with a present membership of 70,000. He indicated the general success of the Sparky campaign and reported that a recent survey on behalf of the Advertising Council showed that some 40 per cent of the American people now know Sparky. He also indicated that many of the current financial problems of the Association may be traced to the expenditures for the Sparky project, there being a cumulative deficit of $80,000 in 5½ years of operation; however, that the very great advertising value in the promotion of public education for fire safety very well justified this expenditure. Mr. Bugbee also reported favorable prospects for income from royalties on the sale of Sparky products and that the budget estimates for the current year indicated that the income from such sources would be sufficient for the first time to balance the expenditures. He mentioned the wide variety of Sparky products on which royalties may be anticipated, including T shirts, belts, raincoats, jewelry, dolls, scarves, books, a calendar, and a fire hat.

Nov. 1956 Meeting

12. Mr. Moulton reported on plans for the 1956 fall meeting to be held at the Hotel Statler, St. Louis, November 26-28, with Mr. W. C. Anderson, Manager of the Missouri Inspection Bureau, serving as Chairman of the local sponsoring committee. The program was discussed. Several members of the Board indicated that they would be available for program participation and suggestions were made for further development of the program which is to be handled as a fall conference rather than as a regional meeting although in the development of the program the needs and interests of NFPA members in the region will be considered.

13. Mr. Bugbee reported on new additions to the NFPA field service Sponsors Committee as follows:

W. H. Burkhart, President
Lever Brothers Company, New York

Cleo F. Craig, President
American Telephone & Telegraph Co., New York

Morse G. Dial, President
Union Carbide & Carbon Corp., New York

A. B. Homer, President
Bethlehem Steel Co., Bethlehem, Pa.

H. E. Humphreys, Jr., President
United States Rubber Co., New York

F. B. McConnell, President
Sears, Roebuck & Co., Chicago

Alfred E. Perlman, President
New York Central System, New York

W. L. Stewart, Jr., Vice-President
Union Oil Co. of California, Los Angeles

K. C. Towe, President
American Cyanamid Co., New York

Thomas J. Watson, Jr., President
International Business Machines Corp., New York

Udell C. Young, Vice-President
General Foods Corp., White Plains

New Life Membership Plan

14. It was voted to recommend to the Association at the next meeting that the Articles of Association be amended to provide for individual life membership in the Association beginning at age 65 on payment of dues of $100, also that in the event that any member wished to subscribe for life membership to age 65 the amount of the lump payment would be based on the current dues multiplied by the number of years the life membership is to be in effect prior to age 65.

Question of Exhibits

15. The NFPA staff was authorized to investigate the matter of having commercial exhibits at NFPA Annual Meetings and report to the Board the staff recommendations thereon, with the understanding that in no event would there be such exhibits in 1957.

Technical Actions Taken

Hospital Operating Rooms

16. In accordance with the authorization of the Annual Meeting, it was voted to adopt in the name of the Association the revised standard on Hospital Operating Rooms, NFPA No. 56, incorporating various revisions in the previous edition of this standard which had been reported by the Committee to the Annual Meeting but had not been acted upon by the Annual Meeting because the proposals had not been preprinted in the 1956 Advance Reports. Prior to this action, Mr. Bugbee read a letter from NFPA legal counsel expressing the opinion that in adopting these amendments including provisions on a hospital operating room electrical plug the Association would not be fostering any patent monopoly or acting in violation of any law on restraint of trade. (The revised text as adopted is to be published in separate pamphlet form, NFPA No. 56, also incorporated in the National Fire Codes, 1956, Vol. I.)

Nonflammable Medical Gas Systems

Also on recommendation of the Committee on Hospital Operating Rooms, it was voted to approve revised drawings illustrating the application of the piping provisions of NFPA Standard No. 565, Nonflammable Medical Gas Systems. (The revised drawings will appear in the 1956 edition of this pamphlet, also in the National Fire Codes, 1956, Vol. I.)

Fueling Aircraft on the Ground

17. On motion of Mr. Bunn who presented comments from the American Petroleum Institute, it was voted to request the Committees on Aviation and Airport Fire Protection and on Flammable Liquids to review Standards Nos. 407 on Fueling Aircraft on the Ground, and 385 on Tank Vehicles for Flammable Liquids, endeavoring to harmonize the overlapping provisions of these standards in the interest of eliminating confusion and to present their recommendations thereon to the NFPA Annual Meeting.

Building Materials

18(a). After consideration of a request from the Committee on Building Materials that certain changes be made in the procedures of the Committees on Building Construction and on Safety to Life to provide better opportunity for building materials interests to register their views, it was voted to refer this communication to the officers of the respective committees with the suggestion that the Committees on Building Construction and Safety to Life make every effort to afford them such opportunity, but not at the expense of interfering with the normal operation of the committees.

A similar communication from a representative of the Metal Roof Deck Technical Institute was also covered in principle by this action.

(b) No action was taken on a recommendation from the Committee on Building Materials that the membership of the Committee on Safety to Life be limited to groups concerned only with life safety and that representatives of equipment manufacturers be eliminated from the committee. It was noted during the discussion that representatives of automatic sprinkler and fire alarm groups have made useful contributions to the Committee and that their presence on the Committee has not operated in any way to interfere with or delay the normal Committee operations.

NFPA and ASA Relations

20(a). On recommendation of the Technical Advisory Committee, the following action was voted:

Act to have the NFPA retire as a member of the ASA Fire Protection Group and suggest to other members of the Group that they proceed individually in their membership and other contacts with the ASA.

Act to apply to the ASA for a separate membership directly in the name of the NFPA and authorize the payment of the dues.

Withdraw as a joint sponsor of the project on Building Code Requirements for Fire Protection and Fire Resistance — ASA A-51, on the ground that this project is now inactive and that the NFPA does not wish to be identified as a sponsor with a project which offers no promise of any constructive results.

Withdraw from the sponsorship of the project on Building Code Requirements for Fire Extinguishing Equipment — ASA A-54, on the ground that this project cannot properly be developed independently of the project on Building Code Requirements for Fire Protection and Fire Resistance. In other words, that the project on Fire Extinguishing Equipment must be based on probable character and size of fire that may be anticipated.

(b) On recommendation of the Electrical Correlating Committee, with the concurrence of the Technical Advisory Committee, it was voted to authorize the NFPA staff to record the Association's views in respect to the suitability of Underwriters' Laboratories' electrical standards for approval by the American Standards Association under the proprietary sponsorship method. The staff was authorized to exercise discretion in respect to individual standards and either record the NFPA as seeing no reason why the standard in question should not be approved in view of the fact that the principal parties at interest had already been consulted, or in case of any doubt on the part of the NFPA staff or any question raised by any NFPA member, refer the standard in question to the Electrical Correlating Committee for recommendation before recording the NFPA view.

(c) It was agreed to submit for ASA approval as American Standard the 1956 edition of the National Electrical Code, the 1956 edition of the Building Exits Code, the 1956 edition of the Code for the Processing and Finishing of Aluminum and the 1956 edition of the Standards for the Installation and Operation of Pulverized-Coal Systems.

Other NFPA Committee Matters

21. The report of the Technical Advisory Committee was presented by Mr. A. L. Brown and action was taken on the recommendations of the committee as follows:

(a) It was voted to assign to the Committee on Building Construction responsibility for consideration of the subject of fire venting and related matters as covered in a communication from the U. S. Fire Protection Engineering Company suggesting a new committee project on this subject.

(b) It was voted to establish a new Committee on Classification of Materials in accordance with the recommendation of the Committee on Flammable Liquids, the scope statement for this committee to read:

"The Classification as to relative hazards of all solids, liquids and gases. This committee cooperates with other NFPA committees concerned."

(c) It was voted to discharge the Committee on Hydrants, Valves and Nozzles, to transfer jurisdiction over standards on hydrants and valves to the Committee on Standpipes and Outside Protection, and standards on hose couplings and nozzles to the Committee on Fire Hose which reports to the Association through the Committee on Fire Department Equipment. It was also voted to transfer to these other committees the present personnel of the Committee on Hydrants, Valves and Nozzles in accordance with the interest of the respective committee members.

(d) It was voted to refer to the Electrical Correlating Committee a request from the National Machine Tool Builders Association for the establishment by the NFPA of machine tool electrical standards with the suggestion that such a project might be appropriately handled by a committee within the framework of the Electrical Section, but separate from the present National Electrical Code Committee. The Electrical Correlating Committee was requested to report back its recommendations on the handling of this matter in due course.

(e) The Technical Advisory Committee also reported its recommendations on committee appointments (see Minute No. 22).

Committee Appointments

22. Technical committee appointments in accordance with the list submitted with the agenda for the meeting

and the supplementary list presented at the meeting, with one exception, were confirmed in accordance with the recommendations of the Technical Advisory Committee, including the following new chairmanships:

Committee on Building Construction — Edwin N. Searl

Committee on Classification of Materials — J. Sharp Queener

Committee on Fire Tests — A. J. Steiner

Committee on First Aid Fire Appliances — Raymond M. Hill

Committee on Signaling Systems and Thermostats — Boyd A. Hartley

It was voted to reappoint for the year 1956–1957 all present members of NFPA technical committees except those who have resigned, retired, or have not been reappointed by reason of lack of participation in committee activities. It was also voted to authorize the Technical Advisory Committee to make further committee appointments prior to the publication of the 1956–57 Year Book, subject to confirmation by the Board at its next meeting.

23. The Technical Advisory Committee for 1956–57 was appointed as follows: A. L. Brown, Chairman, Hylton R. Brown, T. Seddon Duke, John A. Neale, Henry G. Thomas. Mr. Merwin M. Brandon who had been serving on the committee pro tem in connection with consideration of ASA matters was, at his request, relieved of further service on the committee.

Other Items

24. On recommendation of the Committee on Air Conditioning, an amendment dealing with the definition of heat exchangers was incorporated in Standard No. 90B, Residence Type Warm Air Heating and Air Conditioning Systems. (The complete revised text appears in the 1956 edition of this pamphlet, also in the National Fire Codes, 1956, Vol. III.)

25. Mr. Bond reported on the book, FIRE ADMINISTRATION, published by the International City Managers Association, indicating the widespread influence of this volume in the preparation of which the NFPA staff has collaborated. The value of this contribution by the NFPA was emphasized in discussion by Board members.

26. Mr. Bond reported on the fire research activities of the National Research Council Committee on Fire Research organized by the National Academy of Sciences.

27. Mr. Bugbee reported on the activities of the NFPA Fire Services Department, discussing a fire equipment survey of a typical county conducted this spring and expressed the hope that financial support might be forthcoming from the fire equipment industry or other sources to permit further NFPA activities along similar lines.

28. It was voted to hold the next meeting of the Board on Thursday, January 24, 1957 at the Union League Club in New York.

29. A communication was presented from former Board member, Mr. Joe R. Yockers, Fire Marshal of California, expressing his appreciation for the privilege of serving on the Board and his high regard for the caliber of the Board membership and activities.

After a luncheon attended by Board members and additional members of the NFPA staff, the meeting adjourned.

Combustible Fibreboard Tile Ceiling Fire

New Brunswick Board of Underwriters

The combustible fibreboard acoustical tile ceiling provided the principal fuel for the fire in the doctors' library.

On May 14, 1956 a $35,000 fire occurred in the two-story wing of the two- and six-story fire-resistive Moncton (New Brunswick) City Hospital. The fire is of unusual interest because it offers further evidence that combustible interior finish can cause extensive property damage to an otherwise fire-resistive building and represents a threat to life safety, although no lives were lost in this incident.

The fact that no patients were bedded in the two-story wing where the fire was confined probably accounted for the absence of casualties. A small amount of smoke spread to the upper stories of the adjoining six-story section by means of an enclosed elevator shaft but there was no evidence of panic among patients. Employees took their stations according to a prearranged emergency plan, but due to the remoteness of the patients from the fire, the only action taken was to close all doors between the involved wing and the six-story section.

The area of the second story of the wing where the fire occurred was occu-

*Based on a report submitted by the New Brunswick Board of Fire Underwriters.

New Brunswick Board of Underwriters

Debris in doctors' library.

pied by business offices and a doctors' library. These rooms were situated on either side of a 230-ft.-long corridor. All walls were plaster. The ceiling finish in the corridor was suspended metal acoustical tile with non-combustible fibre backing while in the offices and library, the ceiling consisted of combustible fibreboard acoustical tile cemented to the plaster. Door panels were wood veneer and window frames were wood. In the doctors' library, where the fire originated, the principal combustible contents in addition to the ceiling, doors, and windows included a heavy wooden table, several wooden chairs, and books on wooden shelves.

Careless disposal of a cigarette in a wastebasket was the probable cause. Before the fire was discovered by an employee coming on duty at 6:00 A.M., approximately two hours after it was believed to have started, heat had caused the combustible fibreboard tile ceiling to collapse and thereafter an intense fire had developed. The library

Tom Bourgeois

Office opposite corridor from doctors' library.

New Brunswick Board of Underwriters

Corridor near doctors' library. Heat warped the suspended metal acoustical ceiling for a distance of 50 feet from the doorway to the library.

was completely involved and fire had burned through a door to the corridor. The suspended metal acoustical corridor ceiling had warped, exposing the non-combustible fibre backing.

Responding to the employee's immediately telephoned alarm, firemen used a 1½-inch hose equipped with spray nozzle for about an hour to extinguish the library fire and to cool the corridor walls and ceiling. By then the library was gutted, the metal acoustical ceiling in the corridor was warped for a distance of about 50 feet, veneer panels in corridor doors in the vicinity of the library were burned through and smoke damage and cracked plaster had occurred the full length of the corridor.

Because of this fire experience the hospital authorities have decided to install smoke stop doors in the corridors and an automatic fire detection system with the alarm bell located in the always-manned boiler room.

The Case For

Private Fire Protection Engineering Firms

By Frank H. Gage, President

U. S. Fire Protection Engineering Service, Inc.

Fire protection engineering must become established as a full-fledged engineering profession rather than a profession primarily built around inspecting and enforcing compliance with standards. Complete, cost-conscious fire protection engineering provides the only sure means of improving overall industrial fire safety. Today most industry is not receiving a dollar's worth of protection for every dollar spent.

How do you measure a dollar's worth of industrial fire protection? A whole book could be written on the answer to this question. Primarily, however, it is determined by the degree of protection afforded to assure production continuity. First, priority should always be placed on protecting hazards, small or large, which jeopardize production. If available funds are limited, protection for non-critical warehouses, service and office buildings should be held up until production is fully protected. In some cases, more expenditure can be justified for complete protection of a hard-to-replace $200,000 production process than for a $5,000,000 finished product warehouse. Detailed production protection evaluation is part of complete engineering.

Complete Fire Protection Engineering

What is complete fire protection engineering? It is composed of six basic phases. They are:

1. The hazard location or the inspection phase.

2. The complete evaluation of the involved hazard, its attendant conditions, and its criticality to production continuity.

3. The determination of the most practical and economical method of protection or, in other words, the comparison of the cost involved in each of the various methods that could be used to achieve adequate protection.

4. The actual engineering and specification of the best protection method.

5. The execution of the engineered protection.

6. The development of those continuous prevention, control and extinguishment procedures and programs which are vital to the maintenance of over-all fire safety and operational continuity.

These phases are very similar to those involved in all other phases of engineering work — locate the problem, study the condition, determine the best solution, engineer the method, carry it out, and, finally, maintain it when completed.

Engineering services, as furnished by the large industrial fire insurance groups and agencies, provide some assistance in all six phases, but only in the inspection phase are their services essentially complete. They can locate hazards and suggest corrective measures but, because of limited survey time and lack of experience in overall cost estimating, their inspectors should not be completely relied upon to direct the remaining five phases.

Based on an address delivered by the author at the 60th Annual Meeting of the NFPA held in Boston, Massachusetts, June 4–8, 1956.

One example may emphasize this point. A rather extensive flammable liquid storage and mixing area needed some additional protection. An inspector for one of the large preferred risk insurance companies surveyed the area and recommended several specific protection measures. I happen to know this inspector and have a great deal of confidence in his overall knowledge of fire protection. This example should not reflect on his individual ability since he was handicapped by lack of survey time and of experience in cost estimating. The assured's engineering department accepted his recommendations and prepared preliminary plans and a cost estimate. They submitted an appropriation request for $92,000, which management turned down as being overly excessive. Management called in a consulting fire protection engineering firm to survey the hazard and see if there was not a more practical and economical means for protection. This firm developed a protection program, which was acceptable to the insurance interests, and carried out all of the engineering involved. The result was that the total cost was reduced from $92,000 to less than $20,000 without affecting the degree of protection. This is not an isolated case. The fault rests not with the insurance companies but with the industrial companies themselves.

Success in engineering is measured not only by the efficiency or effectiveness of the finished project but also by the magnitude of the total cost required to carry it out. For instance, an engineer could design a complete, approved four-hour fire wall separating two areas each containing a one-half-hour hazard or fire loading. Certainly, the wall would be effective but the engineer could be criticized as the cost would be excessive when compared with that required to achieve practical separation.

One point concerning cost in industrial work should be emphasized. Cost analysis should not be confined merely to capital or construction expenditures. It must also include the expenses involved in maintaining, inspecting, and testing fire protection equipment and in the continual fire prevention and fire fighting activities necessitated by the hazard or protective design. This latter portion of cost is too frequently overlooked. Certain protection methods require less initial expenditure but have higher continuing maintenance cost. Therefore, the method that is cheapest at the outset is not always the cheapest in the long run.

Fire protection engineering is wholly dependent upon the ability of the participating engineers and this dependency is probably more pronounced in our field than in any of the other major branches of engineering. This fact is either not recognized or is arbitrarily ignored by many industrial firms. We have all seen instances where architects or engineers with little or no fire protection experience were placed in responsible charge of engineering protection projects amounting to hundreds of thousands of dollars. To make up for lack of knowledge they call upon any one they can find who will provide them with free assistance. No wonder costs become excessive.

Why is this so? The answer seems obvious. Fire protection engineering deals with problems whose solution cannot be tangibly evaluated as to their actual effectiveness and adequacy. How can you determine the number of fires and explosions that have been prevented by good engineering? How can you accurately evaluate the effectiveness of loss control and extinguishment measures for special hazards unless they are tested to the limit by an actual fire or explosion? — and, of course, you hope the prevention measures that you have provided will never permit such an occurrence. You just are not able to tell or to guarantee. Loss statistics and past experience provide some indication but, particularly for special hazards, it is by no means conclusive. In contrast

to our profession, the overall effectiveness of architectural, mechanical and electrical engineering can normally be ascertained merely by analyzing the completed work.

This discussion emphasizes the imperative need for industrial fire protection engineers who have the fundamental knowledge, the broad practical experience, and the sound judgment necessary to carry out each of the six basic engineering phases successfully. In my opinion, today a large portion of industrial fire protection is directed by men who do not possess all of these qualifications. This is particularly true in the special hazard field. While it is unreasonable to expect that there is any *one* engineer who has all of these qualifications for all phases involved in engineering protection for all types of hazards, architects and industrial company engineers seem prone to accept without question extensive and costly recommendations offered by fire inspectors who have less than four years of inspection experience and no experience in cost-estimating or comparing. I would guess that almost 50 per cent of the total expenditure for fire protection results from this basic approach.

Fundamental Knowledge

What is meant by the term "fundamental knowledge"? It means, here, detailed knowledge of the theoretical and actual mechanics of fires and explosions as well as a broad, analytical understanding of the physical, chemical, and engineering properties of matter. It also includes basic knowledge in production and construction techniques, in personnel management and training, in industrial operating and maintenance procedures. In addition, it should include knowledge in the fundamentals of persuasive selling. An industrial fire protection engineer must be able to convince management of the need for fire protection and that adequate funds must be appropriated.

Fire protection engineering is a complex engineering science and not merely the science of recognizing known hazards and applying standards. Don't misinterpret my remarks, standards are necessary and extremely valuable. They can be compared to an engineer's slide rule. In the hands of an expert, the most complicated problems can be swiftly and accurately solved. In inexperienced hands, simple problems become difficult and their solutions erratic. Fundamental knowledge and the ability to apply it through practical, thorough engineering is far more important than the ability to read, understand and recommend compliance with standards.

Broad, Practical Experience

Broad, practical experience must be added to fundamental knowledge. Broad experience can be gained from inspecting industrial properties and recommending protection measures. But this experience, alone, is not adequate. If it were, then logically all city and state building inspectors would automatically qualify as architects or structural engineers. Broad experience, in order to be practical and complete, must also include experience in estimating and comparing costs for many types of protection; in preparing accurate plans and specifications; in construction materials and techniques; in preventive maintenance procedures; in industrial economics; in fire brigade development and fire prevention program supervision; and in many other items involved in industrial operations.

On this item of cost, there exists a general misconception concerning precisely what should be included within the term "fire protection cost." Generally speaking, today, industry includes only the cost involved in fixed protection systems (water supply and distribution, sprinkler, foam, etc.), alarm and supervisory systems, first aid extinguishers and fire fighting equipment. Yet, in actuality, this represents only a small portion of the total costs directly involved in obtaining overall industrial fire safety even when thinking only of

capital expenditures and not of continuous maintenance costs. For example, suppose you built a plant complete with all necessary production and operating facilities but omitted *all* fire protection, including such items as structural fire resistivity, fire walls, electrical safeguards, ventilation, sprinklers, etc., and that this unprotected plant cost $500,000. Now suppose you built another plant of the same size and with the same facilities but, in this plant, you included all of the fire protection required in order to obtain what the insurance companies would call "a preferred risk." Let's say this fully protected plant cost $850,000. The total overall cost of fire protection becomes the difference between the cost of the protected plant and the unprotected plant, or $350,000, even though the cost of the fixed protection systems and extinguishing equipment might have cost only $70,000. In this example, which is within reason for some of the more hazardous industrial plants, the protected cost was 70 per cent more than the unprotected cost.

This must be recognized as the true interpretation of the term "overall fire protection cost." It is the function and responsibility of the industrial fire protection engineer to hold this overall cost to the minimum necessary to achieve a practical degree of fire safety. Naturally, he cannot do this without engineering and cost estimating experience in the other major engineering fields such as architectural design, mechanical engineering, etc.

This was illustrated recently by one of our engineers. This engineer, since he spends a great deal of his time studying new developments and in cost comparison work, was able to show an industrial company and its architects how a recent development in the building materials field would substantially reduce construction costs without impairing structural fire resistivity or suitability. Following the disaster at Livonia*, this company, at the suggestion of their insurance carriers, standardized on a certain type construction as being the most economical method of achieving the desired degree of fire resistivity for their new buildings. The cost reduction resulting from the use of the newly developed material suggested by our engineer exceeded $300,000 for one project alone. This is good fire protection engineering.

Sound Judgment

How many times have you heard the statement — "Sure I believe that your method will provide adequate protection, but I cannot accept it since it does not completely conform to standards"? Today, it is easier for a fire protection engineer to be a conformist and a follower than to be a thinker and a developer, regardless of how sound his judgment may be or how completely he may have analyzed an involved problem.

For many special hazards involving complex processes, it is necessary to conduct an extensive study and investigation in order to develop a completely effective yet economically sound overall protection program. Frequently, this study period will require days and even weeks. There have been several occasions where the resulting program has been ruled unacceptable by others following only a brief one-half hour study. It was not judged on its protection merits, but upon its conformance with all of the details of all of the applicable standards.

Standards, as prepared by the NFPA and other groups, are indeed necessary and have been of tremendous benefit. Initially, they were developed to serve as guides to fire safety but they have moved past the guide status and today, they serve essentially as the laws of fire protection. Conformance with these laws appears to be the sole criterion for determining adequacy of protection. Yet, we all know that it is impossible

* See NFPA Quarterly, October 1953, Page 105

to prepare and keep up-to-date standards covering every condition involved in every type of hazard and including all of the developments in improved techniques and equipment. How long does it take to prepare and have accepted a new standard covering a new protection method?

Why has this situation developed? Probably, the main reason concerns the failure of fire protection engineering to achieve a position of vital importance in the property design and operations field. Detailed standards of the "bolt and nut" variety are only necessary to fill the gap left by the lack, both in quantity and quality, of available fire protection engineers. Most of our standards have not been written for experienced fire protection engineers. If they were, their length could be reduced, in many instances, by at least 75 per cent. Some of the newer standards, such as those covering Water Spray (NFPA No. 15) and Inerting Systems (NFPA No. 69) are greatly improved in this regard.

Standards, by and large, have attempted to accomplish an almost impossible feat — to tell a man with little knowledge how to engineer something that requires extensive knowledge, experience and judgment. Fire protection engineers complain about the work turned out by many architectural firms. Essentially, this is our own fault. We have been content to develop a standard, print it and then hand it to the architects as if to say this is all that is necessary even though we knew they had little or no specific knowledge and experience in the fire protection field. The owner pays for it — not the architect or the insurance companies. We must strive to develop standards prescribing the necessary end performance for various types of hazards and written specifically for application by men who are experienced in the fire protection engineering field. This is what is done in the other fields. Standards must not restrict sound judgement. If this can be accomplished, better industrial fire safety would become evident.

Conclusion

Real success in industrial fire protection engineering, particularly in the complex special hazards field, can be achieved only by using the combined ability of a staff of fire protection engineers composed of men with complementary experience and knowledge. No single engineer or even two or three engineers is fully qualified to carry out completely and successfully all of the basic phases involved in engineering protection for all types of industrial hazards. Industrial management, however, seems to believe that one engineer can develop, engineer, supervise and direct the maintenance of all fire protection throughout their industrial plants. It just cannot be done by one man alone — a day isn't long enough. It is particularly impossible when this one man attempts to accomplish this by spending most of his time behind a desk. The most important phases of engineering, with respect to effectiveness and cost, are the "on the site" survey or evaluation phase and the cost analysis phase. Yet, these are generally the two phases which are assigned to the less experienced engineers or to the insurance inspectors. You can't engineer protection from a desk or over a telephone. The place for the most experienced engineers is in the field.

The primary purpose of a consulting fire protection engineering firm is to make available to all industrial firms a complete, overall fire protection engineering service. This is a relatively new field, but the results have been highly successful as indicated by the fact that first jobs for industrial firms have always resulted in repeat contracts. Frequently, it has developed into a permanent association where this service is made available on call. Our job is educating industrial management as to what complete fire protection engineering is and what it can accomplish.

Burning Characteristics of "Safety" Film

By Allen L. Cobb, Safety Supervisor

Kodak Park Works, Eastman Kodak Company

Since 1950 all motion picture film produced by the major U. S. and Canadian manufacturers for professional and amateur use has had a "safety" base of cellulose *acetate* or other material which burns slowly. Formerly, most film was made with a film base of cellulose *nitrate*. There still seems to be some confusion over the differences between these two types of film. Where "safety" film is used or stored *exclusively*, no special fire protection precautions are necessary. While the change to *acetate* base film has been an accomplished fact domestically for about six years, some cellulose *nitrate* film is still in circulation and some *nitrate* film will be in storage for years for archival purposes. The NFPA Standards for the Storage and Handling of Cellulose Nitrate Motion Picture Film (NFPA No. 40) should be followed to safeguard life and property where this *nitrate* base film is being stored or handled.

This article illustrates the difference in the ignition and burning characteristics of the two types of film. It should be understood that cellulose *nitrate* contains chemically combined oxygen, sufficient in amount so that this material can partially burn or decompose without the presence of air. The gases formed by such decomposition are both toxic and flammable and may be produced so rapidly as to create a hazard to life and dangerous pressures in enclosed spaces. While the actual heat of combustion of *nitrate* film measured in British Thermal Units per pound is 6,000 to 8,000 compared with 8,000 to 9,000 for wood, the rate of combustion is about fifteen times that of wood in the same form.

Cellulose *acetate* film, in contrast, burns relatively slowly — about the same speed as paper — and the combustion products of burning "safety" film are much less toxic than the gases of cellulose *nitrate*.

Loose Film Burning Tests

At a series of tests, comparisons were made of the burning characteristics of *nitrate* and *acetate* films. Photo No. 1 shows the extent of a fire 15 seconds after ignition of a pile of 1,000 feet of 35 mm. *nitrate* motion picture film which had been placed in a loose pile on the ground and ignited. The burning time

Photo No. 1 — Nitrate

Photo No. 2 — Acetate

was checked with a stopwatch at 38 seconds. The *nitrate* film was completely consumed. Flames reached a height of approximately 12 feet and gave off no visible fumes but did show some fly ash.

In a comparative test, 1,000 feet of 35 mm. *acetate* motion picture film was placed in a loose pile on the ground and ignited using a small wad of wood excelsior. Photo No. 2 shows the resulting fire *at its height*. The burning time was recorded at 218 seconds. The "safety" film was not completely consumed and showed evidence around the edges of melting and curling. The flames of the "safety" film did not exceed two feet in height and gave off a black smoke.

About 1,000 feet of heavy craft paper, 35 mm. wide, was placed in a loose pile under similar conditions. In this case, the burning time was checked as 124 seconds. The flames were approximately two feet in height and considerable blue smoke and fly ash were observed.

About 1,000 feet of cotton fabric, 35 mm. wide, was similarly ignited. Burning time was 155 seconds; flames did not exceed two feet in height; very little fly ash was observed although there was some blue smoke.

Simulated Projector Fires

Two Simplex projector magazines were mounted on a frame in such a way as to simulate the mounting distance which could be found on a theatre projector. *Acetate* "safety" film, a full thousand-foot roll, was placed in the top magazine with a strip of film leading down to the lower magazine which contained part of a roll of *acetate* film. The lower magazine door was left open and film was placed in a disorderly pile beneath as might be found in a theatre following a film break. This small pile of film was ignited with a wad of excelsior and it was observed from Photo No. 3 that while much of the "safety" film on the ground was consumed, the

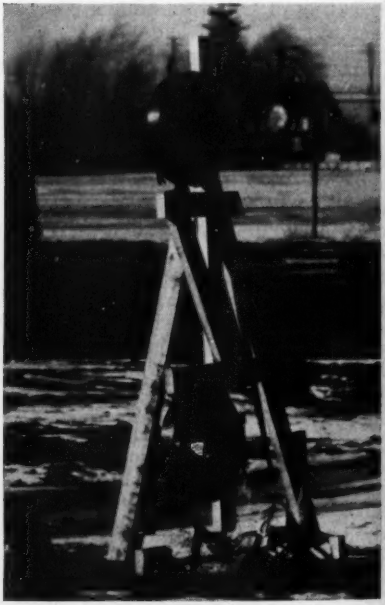

Photo No. 3 — Acetate

flames did not carry up the streamers from the bottom magazine.

Photo No. 4 is the same test repeated but this time *nitrate* film was used in both the top and bottom magazines with the film streamers in approximately the same location. The loose *nitrate* film on the ground was set on fire and immediately the film in the lower magazine ignited and burned with considerable intensity. The streamers from the top magazine burned to the opening in the bottom of the magazine, setting off the roll in the top magazine which burned completely and with considerable intensity. It was observed that the intensity of the flames in both top and bottom magazines was sufficient to melt the white metal holders for the film rolls and to warp and bend the magazines.

Simulated Film Dryer Fires

Using a mock 35 mm. process machine dryer section constructed of two-by-fours with transite sides, top, bottom, and back with center partitions and doors made of *acetate* sheeting for visibility, *acetate* film was threaded throughout the machine to a windup roll on the outside. Film was looped from the windup roll down to the ground as could occur from a nonattended windup. This material was ignited with a wad of excelsior and the film on the ground burned without carrying up to the windup roll as shown in Photo No. 5. The burnout time was 170 seconds.

Photo No. 4 — Nitrate

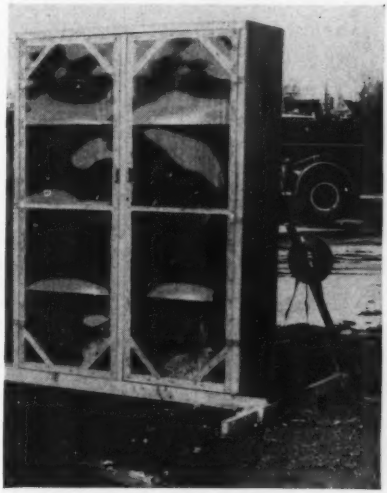

Photo No. 5 — Acetate

After the *acetate* was removed from the machine dryer section, the machine was threaded with 35 mm. *nitrate* film in the same manner as the previous test. The *nitrate* film was ignited and in fifty-five seconds the entire quantity of *nitrate* film was consumed. The fire burned from the loose pile on the ground up to and ignited the windup roll following the film strip from the machine to the roll and igniting the material looped inside the first section of the machine. It burned rapidly inside carrying through to the second section which burned almost immediately, and after the pressure built up inside the machine, the doors blew open and the

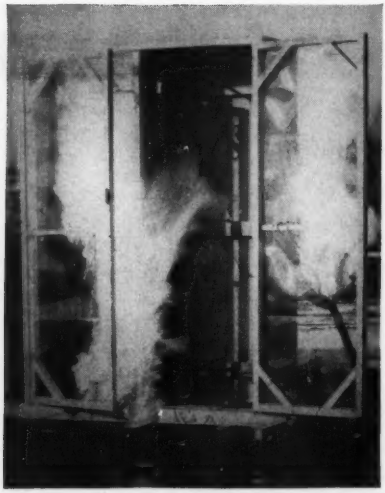

Photo No. 6 — Nitrate

heat was sufficient to melt some of the *acetate* on the doors. Photo No. 6 shows the extent of the fire a few seconds after ignition. It was interesting to note that the *acetate* material on the doors did not ignite and burn.

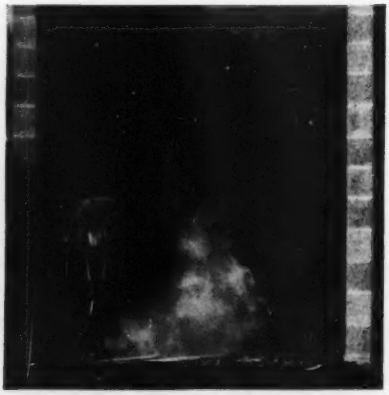

Photo No. 7 — Acetate

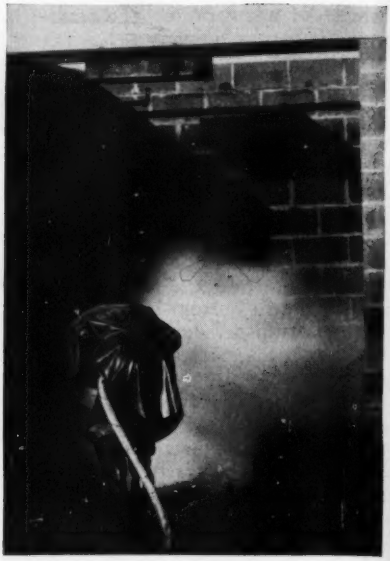

Photo No. 8 — Nitrate

Extinguishment Tests

Approximately 40 pounds of *acetate* film was placed in a loose pile inside an enclosure approximately eight feet wide with an open face. The *acetate* film was ignited and the fire allowed to burn for about two minutes. A fire fighter using a dry chemical extinguisher, as shown in Photo No. 7, readily extinguished the burning film.

Photo No. 8 shows another test fire with 40 pounds of *nitrate* film substituted for the *acetate*. Here the fireman used a water spray nozzle to attempt extinguishment. The flames did not appear to diminish in intensity despite the application of water fog and when the fire was finally extinguished practically all the *nitrate* film in the center of the pile had been consumed.

Small Arms Ammunition in a Fire

By Major General Julian S. Hatcher
United States Army (Retired)

We have occasionally been asked for advice on how those who normally keep guns and a certain quantity of ammunition or ammunition components in their homes, should store these articles so as to minimize the chance of contributing to fire damage.

Powders

Let's first consider powder. Handloaders are likely to have small quantities of powder used for reloading cartridges. Gunpowder is of two kinds: blackpowder, which has now almost entirely gone out of use and is rarely found in a handloader's supplies, and smokeless powder.

Blackpowder presents a special problem in storing and handling. It is unusually easy to ignite, and when once ignited it burns very rapidly even if unconfined. It may be fired by a spark or by heat. For this reason, blackpowder should not be stored and handled in quantity by the individual.

Smokeless powder, while it is more powerful in a gun and gives higher pressures than blackpowder, nevertheless is a relatively safe substance to store and handle. Most types of smokeless powder are plastics very similar in composition to cellulose nitrate. When ignited out in the open smokeless powders burn very much like "celluloid" with a quick, hot flame but no explosion. Caution should be used, therefore, during handling to eliminate open flame sources in the area, particularly smoking materials.

These smokeless powders usually come in small one-pound canisters. If a canister of smokeless powder is in a house which burns, the powder will burn when the fire reaches it. It will add to the heat of the fire at that point—but will not explode.

Cartridges

While it is true that a can of smokeless powder that happens to be involved in a fire will burn fiercely, the same amount of powder in loaded cartridge cases will not burn in that manner, and will not add to the intensity of a fire to any appreciable degree. When small arms ammunition is burned, cartridge cases may burst open and bits of brass may fly about, but not with any great velocity, and usually not with force enough to be dangerous to life. The bullets generally have even less velocity than the brass cartridge cases, as it is necessary for the powder to be rather strongly confined to develop any velocity in a bullet.

The Sporting Arms and Ammunition Manufacturers' Institute of New York reported a demonstration made by taking a large quantity of metallic cartridges and shotgun shells and burning them in a fire of oil-soaked wood. The cartridges and shells exploded from time to time, but there was no general explosion or throwing off of bullets or shot to any distance.

Throughout the test the men conducting it remained within 20 feet of the fire without being injured in any way. That test showed that small arms ammunition, either cartridges or shotgun shells, when subjected to a fire will not explode simultaneously but piece by piece and the material of which the cartridge and shells are composed will usually not fly more than a few feet.

Based on an article published in "The American Rifleman," February, 1946.

In tests conducted by the National Rifle Association, both rifle and pistol cartridges were exploded by heat under an ordinary corrugated pasteboard carton, and neither fragments of the cartridge cases nor the bullets penetrated the cardboard. These tests and years of experience indicate that there is no appreciable hazard in storing any amount of loaded small arms ammunition in a dwelling.

Primers

The most sensitive part of the small arms cartridge is the primer, and many handloaders keep a fairly large quantity of primers on hand for use in reloading operations. There have been attempts in some jurisdictions to impose regulations sharply limiting the number of primers the handloader may have on hand. These regulations have been proposed through ignorance of the fact that primers when issued for handloading or for any other purpose are so packed that there is practically no hazard at all in storing even a large quantity of them.

In one instance a case of primers weighing 75 pounds was shipped by freight from an eastern city to St. Louis and then reshipped to the original point. During shipment it was very roughly handled. The case was almost shattered by a hard fall, one end was broken through, and the contents were damaged, evidently by something being dropped on the case. The case was roughly patched while in transit, one or two big nails being driven through it right into the primers. Notwithstanding this hard treatment, none of the primers exploded.

I had the occasion several years ago to investigate a fire in which a gunsmith shop was burned. In the charred ruins I found a large number of half-burned packages, each containing several thousand primers. Apparently none of the primers had gone off even though the cases containing them were badly charred, some were broken open, and the pastboard containers for the primers were burned on the outside.

Loaded Guns

One thing that could cause a serious accident is the presence of a rifle, pistol, or shotgun, loaded with a cartridge in the chamber or cylinder, in a house where a fire occurs. When the heat reaches the gun, the cartridge will explode and being confined in the chamber will give the bullet its full velocity. If the gun happens to be pointing in a dangerous direction, someone may be killed or injured. It is suggested, therefore, that guns kept in a dwelling house or other building be unloaded for this as well as other safety reasons. That one thing would practically eliminate the gunshot hazard to firemen and bystanders in case of a fire.

— WARNING —

This article discusses conventional small arms ammunition only and not chemical ammunition containing poisons, ammunition for cannon, rocket ammunition, ammunition for small arms with explosive bullets or explosive projectiles, or other types which are classified as Class A or B explosives by the Interstate Commerce Commission.

Fire and Fire Losses Classified, 1955

There were approximately 1,977,950 fires of all types in the United States in 1955 causing a loss of $1,140,768,000. According to estimates compiled by the National Fire Protection Association, the 1955 loss was an increase of approximately $124,000,000 over the $1,017,000,000 estimated loss of 1954. The $31,000,000 increase in the "large loss fire" losses,* the $28,500,000 increase in forest fire losses and the $20,000,000 increase in aircraft losses were the principal factors responsible for this jump to the largest annual fire loss on record.

Building fires in the United States in 1955 totalled 811,800 and caused $943,551,000 damage. An additional 1,166,150 fires not involving buildings — aircraft, motor vehicles, forest, ships, rubbish, grass fires, etc. —accounted for an estimated $197,217,000. Building fire estimates for 1954, reported in the October 1955 Quarterly, showed 774,600 fires with $875,450,000 loss.

The number of building fires for 1955 has increased 4.8 per cent over 1954 figures, while the loss of 1955 is 7.8 per cent more than the previous year.

The data from which Tables I to IV were compiled were obtained from 16 state fire marshals' reports for the year 1955 or the closest fiscal year thereto. The states chosen for inclusion in each of the four tables were selected because of the relative accuracy of their statistics and the completeness of the occupancy and cause classifications. Because of the advancement of the mailing date of the October Quarterly, some state reports, which in past years had been used, did not arrive in time to be included this year.

While the methods of reporting and tabulating fire loss figures differ from state to state, the volume of statistics from the 16 typical states chosen, representing all sections of the country and including both primarily agricultural and industrial states, is sufficiently large to indicate the relative distribution of fires and fire losses. Table I shows the number of fires by occupancy in 13 states and Table II the loss by occupancy in 12 states. Due to the notable increase in the number of fires in motels and tourist cabins, these fires are reported as a separate item this year. Tables III and IV list the number of fires and loss by cause in 14 and 11 states respectively.

Tables V and VI, showing the nation-wide distribution of fires and losses by occupancy and cause, are based primarily on typical state experience enumerated in Tables I to IV. Table VII summarizes statistics from all state reports received.

Various sources have furnished figures for items in Table V. Railroad losses were furnished by the Association of American Railroads, Fire Protection and Insurance Section. Statistics on aircraft fires were compiled by the NFPA Committee on Aviation and Airport Fire Protection. Motor vehicle data are based on a recent survey of 583 U. S. cities (Fire Record of Cities, April, 1956 Quarterly). The estimate of the number of forest fires was compiled by the Forest Service of the U. S. Department of Agriculture.

As will be seen in Table VII, the 17 states with a population of 43,417,000 reported a total of 159,090 fires. Ex-

Continued on page 147

*See "Large Loss Fires of 1955" published in the April 1956 Quarterly.

TABLE I. Number of Fires by Occupancies in Thirteen States — 1955

Occupancies	Iowa	Kansas	La.	Minn.[5]	Mont.	Nebr.	N. H.	N. Dak.[1,3]	Ohio	Ore.[1]	S. Dak.[2]	W. Vir.[4]	Wisc.[1]	Totals
I. PUBLIC BUILDINGS														
Government buildings	3	5	...	...	1	6	2	32	...	25	...	1	14	89
Hospitals, institutions	8	12	25b	12	3	3	4	2b	31	...	2	1	40	143
Schools and colleges	18	24	36	12	4	19	6	12	52	34	12	9	136	374
Churches	21	17	30	15	5	6	7	5	62	40	5	10	105	328
Theatres, including motion pictures	4	4	16	10	1	3	1	...	17	7	2	1	14	80
Amusement, halls	34	14	...	26	10	17	4	...	71	...	6	6	117	305
II. RESIDENTIAL														
Hotels	43	38	289c	60	18	13	17	46	195	324f	26m	2	148	1,219
Boarding and rooming houses	8	12	...	...	10	...	6	...	...	...	...	2	62	100
Apartments	144	93	...	196f	31	92f	41	...	1,550f	...	22	29	217	2,415
Dwellings	1,797	1,313	3,311	1,086	482	665	866	631i	6,121	10,735i	472	682	25,235	53,396
Motels, tourist cabins	6	11	...	4	6	7	2	...	...	...	8	...	45	89
III. MERCANTILE														
Offices, banks	44	14	...	17	6	12	...	...	121	...	10	6	92	322
Restaurants, taverns	110	51	...	72	34	25	13	...	...	107l	8	25	692	1,137
Miscellaneous mercantiles	183	215	300d	216	25	71	76	126	641	511	20n	106	1,042	3,576
Warehouses	45	33	84	57	18	10	6	24	172	17	...	15	167	648
IV. MANUFACTURING														
Metalworkers	23	25	15	12	13	1	1	6	...	19	3	...	106	224
Woodworkers	12	2	26	...	2	...	8	4	...	146	...	4	16	220
Grain mills, elevators	15	18	9	35	5	20	...	10	...	16	6	...	109	243
Food processing	9	9	21	...	1	2	3	5j	...	22	4	2	58	136
Bakeries	6	5	...	12	3	...	3	...	...	4	...	1	14	48
Textile workers	1	1	59	...	...	...	...	10g	...	3	...	...	3	77
Printing	9	5	...	...	...	1	2	...	...	10	1	...	24	52
Laundries	13	9	...	9	11e	...	2e	...	20	21e	2	5e	22	114
Cleaners, tailors	13	...	...	5	...	3g	1	...	32	...	1	...	24	79
Miscellaneous manufacturing	47	19	12	91	2	17	40	8	429	42	19	14	298	1,038
V. MISCELLANEOUS														
Barns	296	401a	142	151	13	346h	40	276h	573	157h	136	29	1,568	4,128
Outbuildings	398	...	...	394	20	135	92	...	567	...	9	13	476	2,104
Lumber and coal yards	6	9	18	21	...	7	1	12	35	...	3	16	16	144
Piers, including shipyards	...	2	...	1	...	...	...	...	...	...	...	...	...	3
Railroad property, inc. rolling stock	23	10	...	10	...	9	...	...	...	...	6	...	320	378
Bulk oil storage, refineries	1	5	47	3	2	3	1	5	...	17	4	1	...	80
Garages	37	10	19	36k	59	55	17	25	688k	23	78k	28	417o	1,492
Filling stations	34	33	...	...	12	...	6	...	...	...	...	6	54	145
Power plants, pump houses	9	5	34	12	...	8	...	4	...	18	1	...	69	160
Creameries and dairies	10	2	...	5	2	4	1	...	...	7	1	1	35	68
Miscellaneous structures	331	6	356	43	11	8	6	7	1,312	28	1	4	283	2,396
VI. OTHER THAN BUILDING FIRES														
Aircraft	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Motor vehicles	596	366	501	119	26	319	...	...	2,545	615	147	33	1,533	6,800
Forest fires	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Rubbish, grass, brush	30	...	...	...	5	120	...	...	...	...	162	...	...	317
Miscellaneous	247	2	...	31	6	24	...	...	95	5	2	32	4,332	4,776
Totals	4,634	2,800	5,350	2,767	847	2,031	1,275	1,250	15,329	12,953	1,229	1,084	37,903	89,452

[1] Insured losses only.
[2] Fiscal year ended June 30, 1955.
[3] Fiscal year ended June 30, 1956.
[4] No losses less than $50.
[5] No losses less than $25.

a. Includes all farm property.
b. Includes public buildings.
c. Includes motels, clubs, boarding houses.
d. Includes offices, banks, restaurants, taverns.
e. Includes dry cleaners.
f. Includes boarding and rooming houses.
g. Includes laundries.
h. Includes farm buildings other than dwellings.
i. Includes apartments.
j. Includes bakeries, creameries.
k. Includes filling stations.
l. Includes offices.
m. Includes restaurants.
n. Includes warehouses.
o. Includes public and private garages.

TABLE II. Fire Losses by Occupancies in Twelve States — 1955

Occupancies	Conn.[1]	Iowa	Kansas	La.	Minn.[2]	Nebr.	N. Dak.[3,4]	Ohio	Ore.[3]	S. Dak.[1]	W. Va.[5]	Wisc.[3]	Totals
I. PUBLIC BUILDINGS													
Government buildings	$ 575	$ 1,257	$ 16,395	.....	.....	$ 118,000	$ 16,570	.....	$ 29,594	.....	$ 300	$ 7,474	$ 190,165
Hospitals, institutions	.....	188,370	365,506	$ 109,921c	$ 31,213	38,658	843c	$ 5,095	.....	$ 1,000	3,100	7,448	751,154
Schools and colleges	189,402	594,580	111,558	53,600	105,328	59,834	4,977	189,662	93,105	367,110	89,604	235,591	2,094,351
Churches	48,251	110,055	252,982	416,645	159,927	44,795	22,587	926,547	54,528	93,475	155,300	92,330	2,377,422
Theatres, including motion pictures	.....	50,600	63,522	103,061	46,925	1,969	.....	9,540	24,721	183	3,000	19,752	323,273
Amusement, halls	83,489	505,667	95,460	.....	377,392	123,248	.....	601,043	.....	178,444	151,195	391,222	2,507,160
II. RESIDENTIAL													
Hotels	38,014	7,803	50,493	487,457d	119,569	5,448	135,783	87,845	285,808f	68,139m	2,825	105,832	1,395,016
Boarding and rooming houses	53,879	3,076	1,417	.....	.....	.....	.....	.....	.....	.....	9,500	13,109	80,981
Apartments	298,857	305,025	158,455	.....	620,093f	202,247f	.....	1,327,742f	.....	11,353	103,350	83,246	3,110,368
Dwellings	2,409,167	2,894,372	987,544	3,287,761	1,905,131	1,216,961	376,006i	7,297,690	4,881,259i	457,294	2,204,974	5,431,799	33,349,958
Motels, tourist cabins	.....	6,985	10,100	.....	331,100	28,955	.....	.....	.....	3,077	.....	15,491	395,708
III. MERCANTILE													
Offices, banks	105,166	63,091	11,630	.....	60,284	26,856	.....	127,930	.....	15,281	99,173	32,880	542,291
Restaurants, taverns	240,410	696,970	96,809	.....	400,739	65,803	.....	.....	197,633k	36,298	240,000	657,049	2,631,711
Miscellaneous mercantiles	844,608	1,266,340	838,189	1,335,109c	2,007,275	789,257	1,179,188	3,101,145	1,494,710	333,450n	1,536,127	1,910,659	16,636,057
Warehouses	431,518	500,932	234,550	595,061	510,610	70,702	64,811	1,394,099	70,318	.....	126,163	982,930	4,981,694
IV. MANUFACTURING													
Metalworkers	460,405	73,779	31,323	94,860	30,172	3,300	66,350	.....	74,369	5,115	.....	562,403	1,402,076
Woodworkers	136,035	17,054	675	174,377	.....	.....	10,784	.....	2,350,525	.....	28,000	17,245	2,734,695
Grain mills, elevators	.....	628,343	159,458	467,608	383,074	563,605	623,253	.....	288,805	52,560	.....	116,245	3,282,951
Food processing	.....	39,234	18,950	226,782	.....	80,075	7,451j	.....	389,340	4,341	7,700	110,737	874,620
Bakeries	3,352	86,128	7,300	.....	24,042	.....	.....	.....	412	.....	150	3,397	124,781
Textile workers	5,051,500	250	600	264,856	.....	.....	3,690h	.....	88,260	.....	.....	1,359	5,410,515
Printing	2,767	99,225	1,005	.....	.....	100	.....	.....	32,458	4,600	.....	62,152	202,307
Laundries	9,824	24,219	54,617	.....	11,755	.....	.....	61,835	99,222l	7,407	11,275l	20,179	301,033
Cleaners, tailors	25,910	18,531	.....	.....	5,750	10,290h	.....	89,240	.....	100	.....	27,053	176,874
Miscellaneous manufacturing	340,530	638,796	226,229	291,911	1,023,419	51,631	16,900	3,830,599	149,580	174,457	533,996	1,331,546	8,609,594
V. MISCELLANEOUS													
Barns	574,272a	1,523,202	1,118,969b	207,552	1,028,007	796,612a	391,646a	4,326,454	350,309a	306,476	204,050	2,617,525	13,445,074
Outbuildings	.....	378,924	.....	.....	303,247	105,392	.....	298,659	.....	3,680	14,740	124,751	1,229,393
Lumber and coal yards	182,864	289,626	292,913	131,377	277,945	226,890	115,780	698,791	.....	1,052	195,528	37,272	2,450,038
Piers, including shipyards	.....	.....	3,570	.....	50	.....	.....	.....	.....	.....	.....	.....	3,620
Railroad property, inc. rolling stock	.....	27,130	8,461	.....	26,600	75,650	.....	.....	.....	1,582	.....	39,009	178,432
Bulk oil storage, refineries	.....	700	18,700	237,439	12,965	5,200	8,995	.....	24,165	2,900	7,000	.....	318,064
Garages	204,635	243,454	32,560	101,546	674,336g	394,499	68,502	625,399g	85,349	263,989g	593,651	261,792o	3,549,782
Filling stations	43,638	55,855	157,281	.....	.....	.....	.....	.....	.....	.....	14,000	20,095	290,869
Power plants, pump houses	.....	1,901	7,100	169,440	23,971	116,487	4,400	.....	29,181	10,000	.....	55,052	417,532
Creameries and dairies	.....	35,003	16,406	.....	54,403	30,650	.....	.....	14,241	4,000	2,500	8,287	165,490
Miscellaneous structures	58,118	316,230	5,061	1,029,767	919,241	71,600	27,470	4,138,684	140,035	115	48,300	117,243	6,871,864
VI. OTHER THAN BUILDING FIRES													
Aircraft	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Motor vehicles	106,836	174,655	124,779	161,644	316,669	245,221	.....	853,905	140,362	84,862	41,824	257,106	2,507,863
Forest fires	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rubbish, grass, brush	.....	8,135	.....	.....	.....	62,573	.....	.....	.....	44,667	.....	.....	115,375
Miscellaneous	973,055	426,038	450	.....	22,510	39,225	.....	5,768	25,420	350	219,780	491,537	2,204,133
Totals	$12,917,077	$12,301,565	$5,581,027	$9,947,774	$11,813,742	$5,671,733	$3,145,986	$29,997,672	$11,414,409	$2,537,357	$6,647,145	$16,258,797	$128,234,284

[1] Fiscal year ended June 30, 1956.
[2] No losses less than $25.
[3] Insured losses only.
[4] Fiscal year ended June 30, 1955.
[5] No losses less than $50.

a. Includes farm buildings other than dwellings.
b. Includes all farm property.
c. Includes public buildings.
d. Includes motels, clubs, boarding houses.
e. Includes offices, banks, restaurants, taverns.
f. Includes boarding and rooming houses.
g. Includes filling stations.
h. Includes laundries.
i. Includes apartments.
j. Includes bakeries, creameries.
k. Includes offices.
l. Includes dry cleaners.
m. Includes restaurants.
n. Includes warehouses.
o. Includes public and private garages.

TABLE III. Number of Fires by Causes in Fourteen States — 1955

Causes	Conn.[1]	Iowa	Kansas	La.	Mich.	Mont.	Nebr.	N. H.	N. D.[1,3]	Ohio	Ore.[2]	R. I.	S. D.[1]	Wics.[2]	Totals
Chimneys, flues — defective or overheated	83	179	70	88	1,609	15	74	122	44	697	938	45	46	1,419	5,429
Sparks on roof	6	125	19	...	745	18	...	...	...	344	179	...	...	291	1,727
Defective or overheated heating and cooking equipment:															
Oil-fired equipment	179	126	...	177	2,728	23	...	51	40	...	...	73	49	652	4,098
Gas-fired equipment	...	20	...	227	...	35	...	...	58	...	...	...	9	168	517
Other and unknown	83	281	219	54	4,034	87	248	201	25	1,248	1,071	117	131	1,170	8,969
Rubbish, ignition unknown	31	302	169	122	8,260	28	186	15	...	491	49	44	119	177	9,993
Combustibles near heaters	5	135	...	...	...	22	22	4	...	...	...	...	...	407	595
Open lights, flames, sparks	37	93	66	408	530	...	56	9	78	343	160	68	66	609	2,523
Hot ashes, coals	8	32	68	...	265	10	5	9	...	106	1,157	1	2	121	1,784
Smoking and matches	339	435	334	655	4,601	97	207	189	207	2,769	3,358	57	116	5,989	19,353
Children and matches	104	199	...	...	2,310	31	72	29	...	788	...	48	60	427	4,068
Electrical, fixed services, fires due to misuse, or faulty wiring and equipment	220	285	306	682a	2,100	52	234	149	120a	2,675	897	122	149	2,222	10,213
Electrical, power consuming appliances	134	271	13	...	3,048	51	92	66	...	465	1,239	2	57	2,139	7,577
Flammable liquids, misuse of including vapor explosions, grease, tar, etc.	68	119	154	...	517	77	161	73	...	908	2,054	45	29	1,989	6194
Flammable liquid appliances, including lamps, blow torches, salamanders, etc.	19	36	...	...	...	10	2	16	...	...	...	...	22	194	299
Torches, welding and cutting	...	46	...	32	...	21	44	14	6	74	...	...	14	48	299
Gas and appliances, including gas explosions	...	14	40	...	525	11	14	11	...	203	...	12	18	42	890
Spontaneous ignition	32	96	22	21	2,699	18	46	16	28	294	95	7	28	228	3,630
Lightning	52	123	64	350	879	29	76	156	67	356	60	22	74	17,328	19,636
Thawing pipes	9	24	...	...	169	18	...	8	...	...	...	...	...	22	250
Sparks from machinery, friction	...	14	19	33	...	3	15	4	11	...	68	...	10	41	218
Incendiary, suspicious	41	25	13	106	894	9	26	22	1	179	47	49	9	66	1,487
Miscellaneous	368	491	127	176	18,949	13	50	31	198	1,601	18	144	87	624	22,877
Unknown	235	785	903	1,820	6,794	125	360	43	306	1,390	1,125	234	125	1,162	15,407
Explosions, miscellaneous and unclassified	10	...	50	...	...	10	5	...	...	...	118	...	...	79	272
Exposure	23	378	144	399	...	34	36	37	61	398	320	23	9	289	2,151
Totals	2,086	4,634	2,800	5,350	61,656	847	2,031	1,275	1,250	15,329	12,953	1,113	1,229	37,903	150,456

[1] Fiscal year ended June 30, 1956.
[2] Insured losses only.
[3] Fiscal year ended June 30, 1955.

a. Includes electrical power consuming appliances.

TABLE IV. Fire Losses by Causes in Eleven States — 1955

Causes	Conn.[1]	Iowa	Kansas	La.	Nebr.	N. D.[2,3]	Ohio	Ore.[2]	S. D.[1]	W. Va.[4]	Wisc.[2]	Totals
Chimneys, flues — defective or overheated	$ 233,488	$ 347,483	$ 70,588	$ 78,262	$ 181,689	$ 178,049	$ 1,082,528	$ 657,972	$ 40,687	$ 197,469	$ 495,563	$ 3,563,778
Sparks on roof	11,276	195,622	37,679	.....	.....	.....	378,451	207,610	.....	.....	211,147	1,041,785
Defective or overheated heating and cooking equipment:												
Oil-fired equipment	299,008	199,127	.....	230,742	.....	40,195	.....	.....	23,683	14,500	421,884	1,229,139
Gas-fired equipment	.....	21,150	.....	936,609	.....	18,975	.....	.....	8,683	14,825	77,213	1,077,455
Other and unknown	220,881	451,265	210,173	45,215	503,860	26,227	2,260,641	637,798	320,802	422,760	921,267	6,020,889
Rubbish, ignition unknown	75,572	213,812	59,073	103,765	161,310	.....	296,070	24,305	55,344	69,342	80,042	1,138,635
Combustibles near heaters	8,968	242,812	.....	.....	24,552	.....	.....	.....	.....	29,206	42,501	348,039
Open lights, flames, sparks	107,273	67,476	125,853	369,863	57,798	54,294	257,374	32,364	57,352	14,241	348,017	1,491,905
Hot ashes, coals	4,562	27,848	334,770	.....	3,886	.....	208,526	499,539	335	3,450	46,643	1,129,559
Smoking and matches	658,491	224,520	238,357	264,805	276,292	213,327	1,238,907	918,294	70,070	184,384	1,401,818	5,689,265
Children and matches	327,597	132,501	.....	.....	71,656	.....	604,702	.....	35,762	.....	237,962	1,410,180
Electrical, fixed services, fires due to misuse, or faulty wiring and equipment	1,381,048	1,259,232	490,204	676,666a	613,633	632,462a	4,546,257	1,589,079	318,923	1,122,228	2,917,238	15,546,970
Electrical, power consuming appliances	140,755	248,695	3,063	.....	276,781	.....	306,506	360,091	52,473	231,850	919,235	2,539,449
Flammable liquids, misuse of including vapor explosions, grease, tar, etc.	87,519	116,246	144,893	.....	239,679	.....	1,046,877	411,759	23,813	125,455	598,583	2,794,824
Flammable liquid appliances, including lamps, blow torches, salamanders, etc.	28,949	12,539	.....	.....	1,747	.....	.....	.....	51,625	.....	255,146	350,006
Torches, welding and cutting	.....	183,685	.....	42,257	57,478	1,225	228,055	.....	6,747	123,425	100,898	743,770
Gas and appliances, including gas explosions	.....	24,274	55,596	.....	45,809	.....	336,954	.....	51,519	95,902	17,244	627,298
Spontaneous ignition	134,428	353,957	47,861	87,540	103,490	50,697	827,469	153,117	66,617	70,830	1,038,847	2,934,853
Lightning	162,935	558,170	136,120	214,339	156,780	201,635	1,094,666	51,361	238,059	357,054	1,967,035	5,138,154
Thawing pipes	32,855	26,734	.....	.....	.....	.....	.....	.....	.....	10,650	23,262	93,501
Sparks from machinery, friction	.....	55,508	11,407	277,660	36,583	58,518	.....	956,022	37,456	10,519	16,734	1,460,407
Incendiary, suspicious	255,169	185,182	59,991	146,374	707,910	81	880,124	166,906	35,243	245,253	189,490	2,871,723
Miscellaneous	1,148,149	297,923	80,962	113,752	148,829	68,499	1,862,739	787	55,660	318,500	651,275	4,747,075
Unknown	2,465,215	5,922,005	3,082,340	6,007,335	1,892,346	1,353,190	11,602,723	4,230,352	979,364	2,301,641	2,568,449	42,404,960
Explosions, miscellaneous and unclassified	5,096,200	.....	141,935	.....	9,750	.....	.....	201,254	.....	164,884	347,796	5,961,819
Exposure	36,739	933,799	250,162	352,590	99,875	248,612	938,103	315,799	7,140	518,777	363,508	4,065,104
Totals	$12,917,077	$12,301,565	$5,581,027	$9,947,774	$5,671,733	$3,145,986	$29,997,672	$11,414,409	$2,537,357	$6,647,145	$16,258,797	$116,420,542

[1] Fiscal year ended June 30, 1956.
[2] Insured losses only.
[3] Fiscal year ended June 30, 1955.
[4] No losses less than $50.
a. Includes electrical power consuming appliances.

Table V. Estimated Distribution of U. S. Fire Losses by Occupancies, 1955

These estimated figures are intended to show the relative order of magnitude of fire losses by occupancies, and while they are reasonable approximations based on the experience in typical states, they should not be taken as exact records for each class. As explained in the text, 100 per cent has been added in estimating the number of fires, and 33⅓ per cent has been added to the losses to cover unreported losses.

	No. of Fires		Losses	
I. Public Buildings				
Government buildings	1,300		$ 2,550,000	
Hospitals, institutions	1,600		3,574,000	
Schools and colleges	4,500		21,500,000	
Churches	3,500		14,180,000	
Theatres, including motion pictures	1,600		2,050,000	
Amusement, halls	3,900	16,400	8,256,000	$ 52,110,000
II. Residential				
Hotels	15,800		10,675,500	
Boarding and rooming houses	7,800		7,080,000	
Apartments	35,600		18,500,000	
Dwellings	491,000		245,500,000	
Motels, tourist cabins	2,000	552,200	1,380,000	283,135,500
III. Mercantile				
Offices, banks	8,400		10,064,000	
Restaurants, taverns	19,600		29,650,000	
Miscellaneous mercantiles	37,600		113,000,000	
Warehouses	7,000	72,600	34,600,000	187,314,000
IV. Manufacturing				
Metal workers	3,100		29,362,000	
Woodworkers	4,300		33,400,000	
Grain mills, elevators	4,100		28,376,000	
Food processing	2,400		3,732,000	
Bakeries	1,100		3,058,000	
Textile workers	6,700		18,612,000	
Printing	1,300		3,060,000	
Laundries	1,900		2,784,000	
Cleaners, tailors	1,800		1,690,000	
Miscellaneous manufacturing	10,900	37,600	64,600,000	188,674,000
V. Miscellaneous				
Barns	43,500		81,900,000	
Outbuildings	26,700		6,500,000	
Lumber and coal yards	1,700		9,700,000	
Piers, including shipyards	1,800		14,355,000	
Railroad property, inc. rolling stock	5,100		11,582,500	
Bulk oil storage, refineries	1,600		29,400,000	
Garages	18,700		24,150,000	
Filling stations	4,100		5,030,000	
Power plants, pump houses	2,800		4,840,000	
Creameries and dairies	1,800		3,860,000	
Miscellaneous structures	25,200	133,000	41,000,000	232,317,500
Total (Building Fires)		811,800		$ 943,551,000
VI. Other Than Building Fires				
Aircraft	350		90,000,000	
Motor vehicles	162,500		17,400,000	
Forest fires	145,200		72,917,000	
Rubbish, grass, brush	800,000		.....	
Miscellaneous	58,100	1,166,150	16,900,000	197,217,000
Grand Total		1,977,950		$1,140,768,000

perience indicates that this is somewhat under half the actual number of fires in these states. Some states, for example, do not report fires with uninsured losses, others report only fires with losses in excess of $50.

To obtain national estimates of the number of fires by occupancy 100 per cent was added to the number reported by the thirteen states shown in Table I. Making use of this figure and population ratios, the number of fires by occupancy in the United States was calculated. Further adjustments were made based upon other surveys of 1955 fire experience. Following a similar procedure with the state experience shown in Table III, national estimates of the numbers of fires by cause were obtained.

To obtain the estimated national fire loss by occupancy and cause, the population ratio was applied to the loss of the states shown in Tables II and IV. To account for losses not reported through the usual channels, 33⅓ per cent was added as in the previous years. Further adjustment was necessary in a few instances because of unusually large damage in individual fires.

Table VI. Estimated U. S. Building Fire Losses by Causes, 1955

These estimated figures are intended to show the relative order of magnitude of fire losses by causes, and while they are reasonable approximations based on the experience in typical states, they should not be taken as exact records for each class.

	No. of fires	Losses
Chimneys, flues — defective or overheated	37,500	$ 27,500,000
Sparks on roof	13,300	9,510,000
Defective or overheated heating and cooking equipment—		
Oil-fired equipment	47,600	41,300,000
Gas-fired equipment	6,700	7,300,000
Other and unknown	46,200	44,000,000
Rubbish, ignition unknown	59,400	15,600,000
Combustibles near heaters	16,800	13,850,000
Open lights, flames, sparks	22,200	17,470,000
Hot ashes, coals	17,100	14,300,000
Smoking and matches	122,000	66,700,000
Children and matches	29,900	13,120,000
Electrical, fixed services, fires due to misuse or faulty wiring, equipment	63,900	81,600,000
Electrical, power consuming appliances	36,000	19,300,000
Flammable liquids, misuse of including vapor explosions, grease, tar, etc.	40,600	35,200,000
Flammable liquid appliances, inc'l lamps, blow torches, salamanders, etc.	4,900	2,740,000
Torches, welding and cutting	4,400	11,092,000
Gas and appliances, including gas explosions	9,800	13,400,000
Spontaneous ignition	26,900	45,000,000
Lightning	44,800	36,800,000
Thawing pipes	2,100	2,520,000
Sparks from machinery, friction	4,100	9,880,000
Incendiary, suspicious	9,600	27,100,000
Miscellaneous	42,500	22,885,000
Unknown	74,300	298,374,000
Explosions, miscellaneous and unclassified	7,400	31,160,000
Exposure	21,800	35,850,000
TOTALS	811,800	$943,551,000

Table VII. Fires per 1000 Population and Fire Loss per Person for Seventeen States, 1955, as Reported by Fire Marshals

State	Population 1955 Est.	No. of Fires	Fires per 1000 Pop.	Fire Loss	Fire Loss per Person
Connecticut	2,268,000	2,086	0.92	$ 12,817,077	$ 5.65
Iowa	2,702,000	4,634	1.71	12,301,565	4.55
Kansas	2,082,000	2,300	1.10	3,844,824	1.85
Louisiana	2,960,000	5,350	1.81	9,947.774	3.36
Maryland[1,2,3,4]	1,632,000[4]	4,668	2.86	3,844,525	2.35
Michigan	7,330,000	61,656	8.43	34,116,558	4.65
Minnesota[5]	3,197,000	2,767	0.87	11,813,742	3.69
Montana[6]	636,000	847	1.33	2,065,594	3.26
Nebraska	1,383,000	2,031	1.47	5,671,733	4.10
New Hampshire	560,000	1,275	2.28	4,402,264	7.85
North Dakota[7,2]	644.000	1 250	1.94	3,145,987	4.90
Ohio	9,077,000	15,329	1.69	29,997,672	3.31
Oregon[2,8]	1,685,000	12,953	7.68	11,414,409	6.75
Rhode Island[9]	851,000	1,728	2.06	9,929 612	11.65
South Dakota[1]	683,000	1,229	1.80	2,537,357	3.72
West Virginia[3]	2,002,000	1,084	0.54	6,647,145	3.33
Wisconsin[2]	3,725,000	37,903	10.42	16,258,797	4.38
TOTALS	43,417,000	159,090	3.67	$180,756,635	$4.17

[1] Fiscal year ended June 30, 1956.
[2] Insured losses only.
[3] No losses less than $50.
[4] Does not include Baltimore.
[5] No losses less than $25.
[6] Buildings and contents loss only.
[7] Fiscal year ended June 30, 1955.
[8] Actual losses when claims were made.
[9] Fiscal year ended Sept. 30, 1955.

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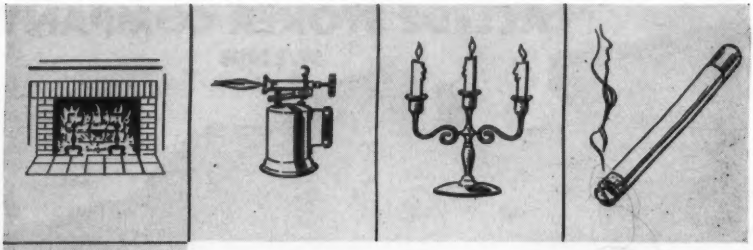

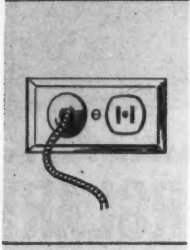

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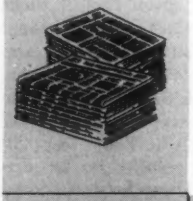

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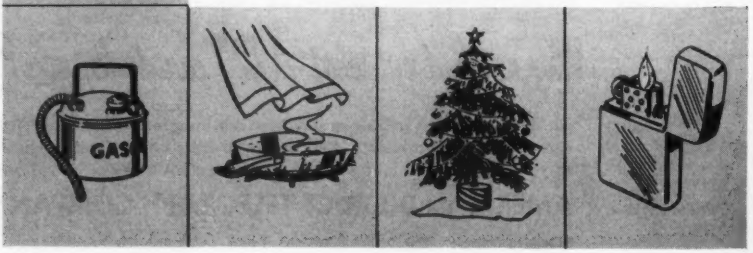
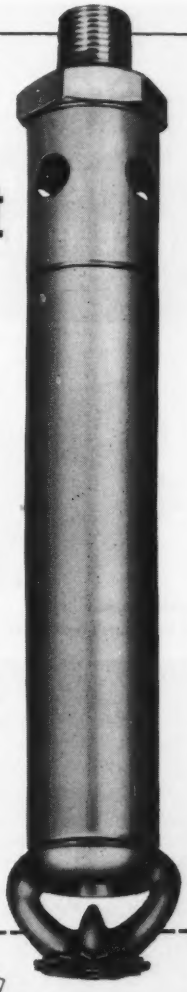


New Rockwood FOAMwater Sprinklers blanket burning liquids faster



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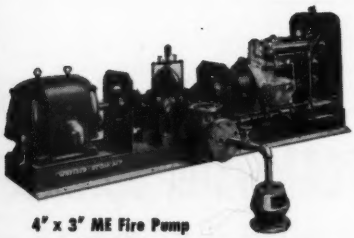

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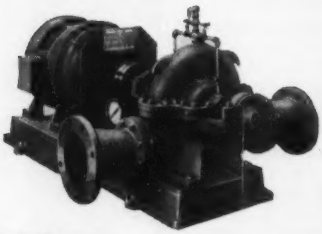

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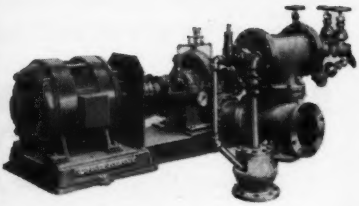

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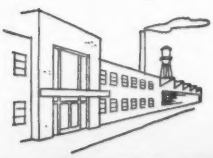

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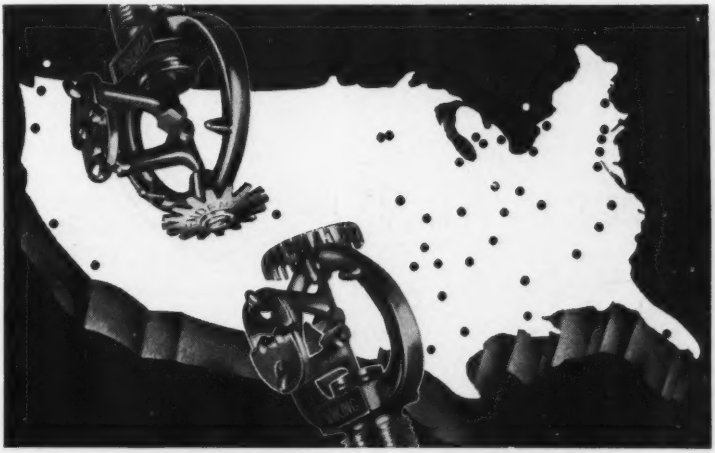


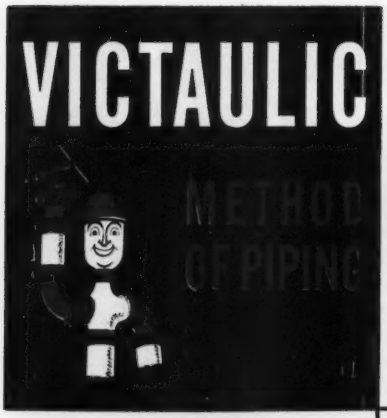
VIKING SPRINKLER FIRE PROTECTION

for any condition whatever it happens to be!

ATLANTA — Crawford & Slaten Co. BOSTON—Viking Automatic Sprinkler Co. BUFFALO—Viking Automatic Sprinklers, Inc. CHICAGO, MILWAUKEE — Viking Automatic Sprinkler Co. CINCINNATI, CLEVELAND, INDIANAPOLIS, LOUISVILLE —Viking Sprinkler Co. DALLAS, HOUSTON, JACKSON (Miss.), MEMPHIS, NEW ORLEANS, N. LITTLE ROCK, SAN ANTONIO, TULSA — Texas Automatic Sprinkler Co. DETROIT — Viking Sprinkler Co. GRAND RAPIDS — Viking Sprinkler Co. of Western Mich. HIGH POINT, N. C. — Viking Sprinkler Co. HUNTINGTON, W. VA.—C. W. Hutchinson, Inc. DECATUR (Ill.), DENVER, KANSAS CITY (Kan.), OMAHA, SAINT LOUIS — Walton Viking Co. LOS ANGELES, SAN FRANCISCO—California Viking Sprinkler Co. HILLSIDE (N. J.), NEW YORK, MANCHESTER (Conn.) — Viking Sprinkler Co. PHILADELPHIA, WASHINGTON (D. C.)—Viking Sprinkler Co. PORTLAND (Ore.), SEATTLE, VANCOUVER (B. C.) — Viking Automatic Sprinkler Co. ST. PAUL, MINNEAPOLIS—Hudson Viking Sprinkler Co. TAMPA — Florida Fire Sprinklers, Inc. TORONTO (Ont.) — Viking Automatic Sprinklers, (Canada) Ltd. WINNIPEG (Man.) — J. C. Davis, Ltd. HASTINGS (Mich.) — The Viking Corporation.

the VIKING corporation

HASTINGS, MICHIGAN



VICTAULIC COUPLINGS *

Styles 77, 77-D for standard applications. Simple, fast to install—sturdy and reliable. Sizes ¾" to 30". Style 75 Light-Weight Couplings for light-duty applications. Sizes 2", 3", 4". Additional styles for cast iron, plastic and other pipes. Sizes through 60".

ROUST-A-BOUT COUPLINGS *

Style 99 for plain or beveled end pipe. Best engineered, most useful plain end joint on the market. Simple, husky — easy and fast to install. Takes strong bull-dog grip on pipe. Sizes 2" to 8".

VICTAULIC FULL-FLOW FITTINGS

Complete line of Elbows, Tees, Reducers, Laterals, etc. — to fit all Victaulic Couplings. Streamlined for top efficiency, easy to install. Sizes ¾" to 12".

VIC-GROOVER TOOLS

Handy, on-the-job grooving tools that do the job in half the time. Light weight, easy to handle — operate manually or from any power drive. Automatic groove position and depth. Sizes ¾" to 8".

***APPROVED BY:**

Factory Mutual

New York City Board of Standards and Appeals, Cal. #413-53-SM.

Underwriters' Laboratories, Inc.

Proven for 26 years on both wet and dry Fire Protection Systems. Standard with most major sprinkler companies for bulk-run and cut-in piping. Victaulic Couplings are installed in *less than one-half the time* required for other standard pipe joints.

THE EASIEST WAY TO MAKE ENDS MEET

VICTAULIC

COMPANY OF AMERICA

P.O. Box 509, Elizabeth, N. J.

This is the type of fire that is

KILLED FAST BY

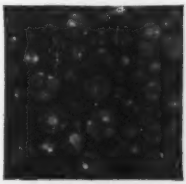
Nicerol

Foam Blanket— AND WILL STAY DEAD

A dense blanket of adhesive, cohesive foam which actually follows the fire, stifles it, outlasts it and prevents flash-back—that's Nicerol, most widely used foam compound in the world.

Nicerol, with pH 6.8 to 7.3, ensures freedom from corrosion in equipment and storage drums. It does not form sludge. 3 gallons of Nicerol NLXX (3%) Foam Liquid with 100 gallons of water, fresh or salt, forms 1,000 gallons of foam.

It can cost you nothing to test Nicerol this way. Write the one word SAMPLE on your official stationery and we will send you, freight pre-paid anywhere in the U.S.A. or Canada a 5-gallon can of Nicerol NLXX (3%) for $20 C.O.D. (or please enclose draft). The $20 cost of this sample will be deducted from your first 100 gallons or larger order for Nicerol.



Photomicrograph X30, showing closely-knit bubble blanket of Nicerol foam, strongly cohesive, adhesive, outlasting the fire.

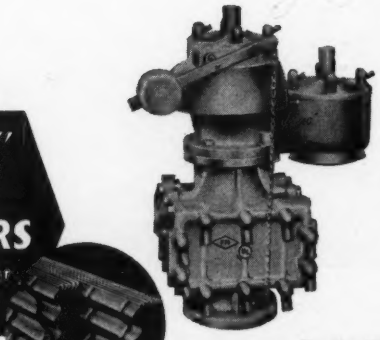
Full technical and commercial details available from:

GEORGE REYNOLDS & ASSOCIATES, P.O. BOX 395, THORNWOOD, NEW YORK
THE GENERAL DETROIT CORP., P.O. BOX 263, DETROIT 32, MICHIGAN
THE GENERAL PACIFIC CORP., 8740 WEST WASHINGTON BLVD., CULVER CITY, CALIF.

LOW COST
FIRE & EXPLOSION PROTECTION

for FLAMMABLE LIQUID STORAGE

WITH "Varec" FLAME ARRESTERS in combination with your VENT VALVES



Flame Arrester Unit listed by UNDERWRITERS' LABORATORIES Approved by Associated Factory Mutuals Laboratories and other governing agencies.

Fig. No. 5800A Conservation Vent Unit consisting of VAREC Vent VALVE in combination with VAREC FLAME ARRESTER

You can rely on VAREC CONSERVATION VENT UNITS to provide full fire protection on your liquid storage at low cost. Protection against entry of flame through the venting device is certain when Varec Flame Arresters are used. Protection against excessive pressure or vacuum is assured by the VAREC VENT VALVE. The combination unit gives you complete security against major hazards of flammable liquid storage. Average installation costs 1/10th of 1% of your investment in tank and products. Secure full details from your VAREC Representative or write factory.

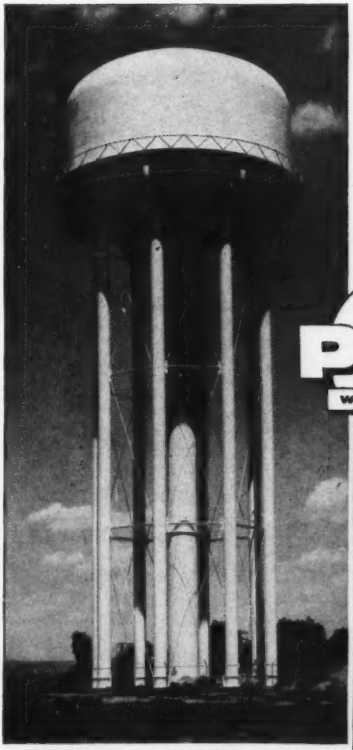
NF-3

"Varec"

THE VAPOR RECOVERY SYSTEMS COMPANY

COMPTON, CALIFORNIA, U. S. A.

Cable Address: VAREC COMPTON USA (All Codes)



750,000 gallons capacity. Tank diameter 62 ft. Head range 35 ft. Height to bottom 120 ft.

The long and the short of

BETTER WATER SERVICE

IN *Pueblo, Colo.*

PDM WATER STORAGE TANKS

1,500,000 gallons capacity. Tank diameter 88 ft. Head range 35 ft. Height to bottom 70 ft.

Balancing the water service requirements of the City of Pueblo, Colorado, these strategically-located Pittsburgh-Des Moines Radial Cone Elevated Steel Tanks provide, with a 50-ft differential in tower heights, uniform water pressures over a large service area. Dependable supply is coupled with low head-range in this large-capacity tank type. Ask for our latest Catalog covering the complete range of PDM Elevated Steel Tanks.

PDM WATER STORAGE TANKS

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES, SANTA CLARA, FRESNO, and CADIZ, SPAIN

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EL MONTE, CAL.....P. O. Box 2068
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incorporating the latest changes and additions voted at the June 1956 NFPA Annual Meeting

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GIVES YOU MORE — FOUR WAYS

UPRIGHT SPRAY SPRINKLER

PENDENT SPRAY SPRINKLER

APPROVED BY
FACTORY MUTUAL LABORATORIES

SIDEWALL SPRINKLER

LISTED BY
UNDERWRITERS' LABORATORIES, Inc.

SMALL ORIFICE SPRINKLER
(With Identifying Pintle)

1 **SUPERIOR PROTECTION** . . . due to more efficient water distribution. Proven by tests under actual fire conditions for all classes of hazards.

2 **MORE EFFECTIVE USE OF LESS WATER** . . . because wider distribution and break-up of the water discharged provides greater cooling and extinguishment.

3 **CEILING PROTECTION BY COOLING — NOT WETTING** . . . All the water goes onto the fire. The break-up of water results in complete cooling and control of flammable vapors.

4 **MORE FIRE CONTROL WITH FEWER SPRINKLERS** . . . because ceiling temperatures are kept lower, fewer sprinklers open. Immediate water saturation of the fire area prevents the spread of fire. Hot gases become impotent in the cooled atmosphere.

STAR SPRINKLER CORPORATION

Westmoreland & Collins Sts., Phila. 34, Pa.

Licensees in principal cities of the United States and Canada

"SAFETY SYSTEM" INDIVIDUAL GAS VENT TABLES

4 INCH SIZE

VENT DIAMETER—INCHES

4 INCH SIZE

LENGTH OF LATERAL, FEET	Total Height of Vent (in feet) from Draft Hood to Top								
	4	6	8	10	15	20	30	40	50
	Allowable Span of Vent Operation, Expressed as Rated Hourly Heat Input (1000 BTU Per Hour) of Gas Appliance Being Vented.								
0 (No lateral)	6 to 80	7 to 86	8 to 95	11 to 102	14 to 115	18 to 120	33 to 131	46 to 137	61 to 140
2	6 to 57	8 to 67	11 to 75	12 to 81	16 to 95	23 to [illegible]	35 to 115	52 to 127	66 to 128
5	7 to 55	11 to 64	13 to 71	16 to 78	[illegible]	[illegible]	41 to 113	55 to 120	77 to 123
10	10 to [illegible]	[illegible] to [illegible]	19 to 66	22 to 74	27 to 85	36 to 95	50 to 108	65 to 115	80 to 120
15	[illegible]	[illegible]	29 to [illegible]	31 to 69	35 to 81	44 to 90	59 to 102	72 to 110	94 to 115
20	[illegible]	[illegible]	39 to 60	41 to 65	45 to 77	50 to 85	72 to 99	83 to 108	105 to 112
25	[illegible]	[illegible]	48 to 56	50 to 62	55 to 73	60 to 79	79 to 95	S and C	S and C
30	S and C	S and C	S and C	S and C	S and C	S and C	S and C	S and C	S and C

NEW

Shown above is 1 of 10 Metalbestos tables covering almost every type of gas vent installation.

"It stands to reason...they're good for gas"

For the first time, the gas industry has a sound, sensible method for eliminating the age-old problem of unsightly and unsafe vent installations. It's the new Metalbestos "Safety System" Gas Vent Tables. Based on established scientific principles . . . extensively tested in the laboratory and the field, they now make it easy to insure correct, streamlined gas venting for every gas appliance installed.

FREE COPIES ARE NOW AVAILABLE – While primarily intended for the heating contractor, Metalbestos "Safety System" Gas Vent Tables are a valuable reference for everyone connected with the gas industry. Contact your local Metalbestos representative or write to Dept. T-10

ANOTHER FIRST BY THE LEADER IN GAS VENTING

METALBESTOS DIVISION
WILLIAM WALLACE COMPANY · BELMONT, CALIF.

Stocked by principal jobbers in major cities. Factory warehouses in Atlanta, Dallas, Newark, Des Moines, Chicago, New Orleans, Akron, Los Angeles.

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HEAVY DUTY ALARM BELLS

GONGS and BUZZERS

Weatherproof
Watertight

Weatherproof —
Sizes 3", 4", 6", 8", 10", 12"
DC—6—220 V. · AC—12—220 V.

Watertight —
Sizes 3", 4", 6", 8", 10", 12"
DC—6—220 Volt · AC—12—220 Volt
60 Cycles, 110—220 Volt, 25 Cycles

Special Windings on request.

Seal of approval by UNDERWRITERS' LABORATORIES • MUTUAL LABORATORY, INC. • UNITED STATES COAST GUARD

AUTOMATIC BATTERY CHARGER, High and Low Current

The unit is designed for use on any storage batteries not subject to heavy drains. It will trickle charge the battery indefinitely because of its automatically decreasing rate of charge.

For use with six cells (12 volts). Automatically controlled by saturable reactor. Continuous output one ampere. 22.5 watts, 118 volts, 60 cycles. 3% Regulation. 9" x 9" x 6" — 14 B & S gauge steel wall cabinet. 15¼ lbs. U.L. Approved. No moving parts.

MODEL BC-12

Manufacturers of a complete line of

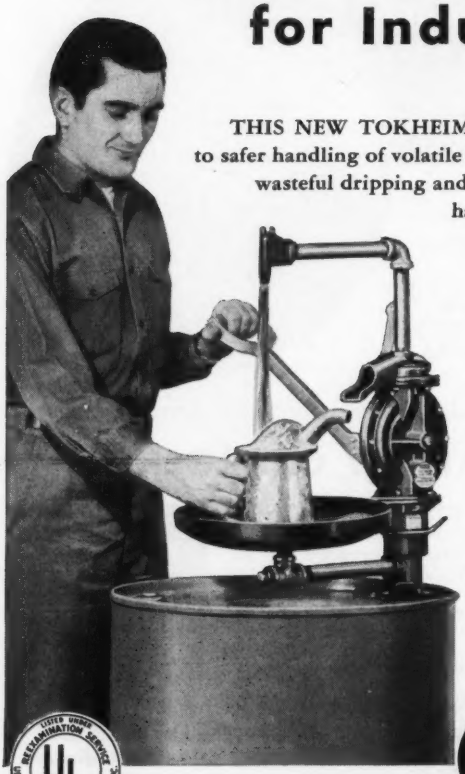
CENTRAL OFFICE and LOCAL FIRE ALARM DEVICES

• automatic alarm devices • sprinkler alarm and supervisory devices • burglar alarm devices and accessories. DYNALARM (sound detection for both reverberant and non-reverberant vaults).

THE REEVE ELECTRICAL CO., Inc.
120 West 42nd Street, New York 36, N.Y.

SAFER

liquid handling for Industry



THIS NEW TOKHEIM HAND PUMP contributes to safer handling of volatile liquids wherever used. Stops wasteful dripping and slippery floors. Reduces fire hazard and accidents common to other methods of liquid transfer. Approved for handling petroleum liquids —ideal for many others. Available in 22 different models for 'most any use— from pipe lines to drums, or underground tanks, with hose or spout outlets. Order from your dealer, your oil company, or your Tokheim representative.

Write factory for literature.

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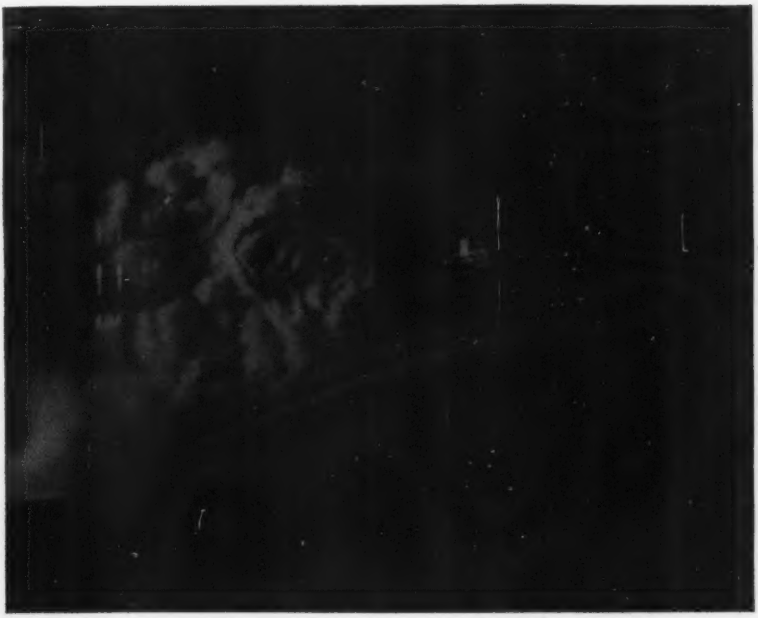


FACTS about FIRES and Fire PROTECTION systems

1 out of every 7

Each year, serious fire strikes one out of every seven manufacturing firms in this country. Lives are lost. Equipment, buildings and *records* are destroyed. Inventories are in ashes.

43 out of every 100

Out of every 100 of these firms that merely lose their records as a result of fire, *43 never open* for business again.

9 out of 10

And that is all so unnecessary... because in 9 cases out of 10 no investment is required by Blaw-Knox to install the most effective means of protection against fire loss... a Blaw-Knox *Automatic* Sprinkler System. And the system pays for itself in a few years by savings in reduced insurance premiums.

"Little Joey Sprinkler" always on the job

50th Anniversary BLAW-KNOX 1906-1956

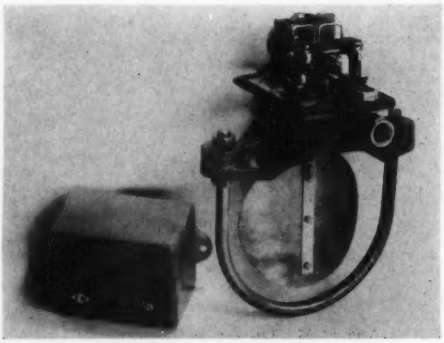
BLAW-KNOX COMPANY

Automatic Sprinkler Department
829 Beaver Avenue, N. S., Pittsburgh 33, Pa.

CENTRAL STATION SIGNALS, INC.

Manufacturers of all kinds of approved devices used in Central Station Systems or Class 'A' or Class 'B' Proprietary Fire Alarm Systems, either automatic or manual.

53 WEST 23rd STREET . . . . . NEW YORK 10, N. Y.



Model PRS-1 Sprinkler Waterflow Alarm

This device is approved by Factory Mutual Laboratories and Underwriters' Laboratories, Inc.

- This device is also made as Model PRT-1, a coded waterflow transmitter.

5-inch size shown above. To install simply drill 2-inch hole in pipe.

- Also made in explosion proof models.
- Made in all sizes from 2½" to 8".
- Has instantly recycling pneumatic retarding device, which prevents false alarms.
- Has enclosed electrical contacts for any voltage not exceeding 15 amp. 125 volts, A.C. and ½ amp. 125 volts, D.C. Operates on all water pressures or surges.

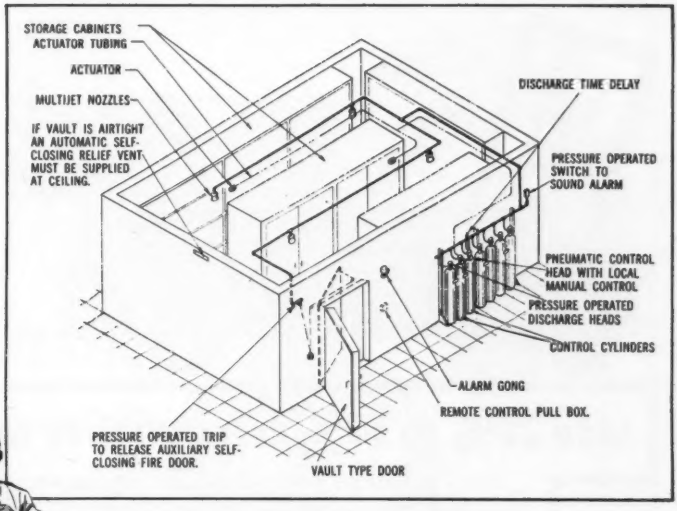
Size is 1⅝" x ⅝"

Tempo-Set Model A Fire Detector

Underwriters' Laboratories, Inc. Approved.

- Self restoring and can be heat tested.
- Electrical contacts are silver or gold and are enclosed.
- Very reasonable price.

- Tempo-set Model A is approved in either open or closed circuit and the temperature ratings are 135 and 200 degrees.
- Approved spacing is 20' x 20'.
- Electric ratings are 125 volts 1 ampere, A.C. or 24 volts 0.5 ampere D.C. or less.


STORAGE CABINETS
ACTUATOR TUBING
ACTUATOR
MULTIJET NOZZLES
IF VAULT IS AIRTIGHT AN AUTOMATIC SELF-CLOSING RELIEF VENT MUST BE SUPPLIED AT CEILING.
DISCHARGE TIME DELAY
PRESSURE OPERATED SWITCH TO SOUND ALARM
PNEUMATIC CONTROL HEAD WITH LOCAL MANUAL CONTROL
PRESSURE OPERATED DISCHARGE HEADS
CONTROL CYLINDERS
ALARM GONG
REMOTE CONTROL PULL BOX.
PRESSURE OPERATED TRIP TO RELEASE AUXILIARY SELF-CLOSING FIRE DOOR.
VAULT TYPE DOOR

GUARD VALUABLE RECORDS WITH THIS ENGINEERED FIRE PROTECTION!

JUST let fire destroy one irreplaceable set of records – or original drawings—and your business stands a good chance of bankruptcy! And keep in mind that 44% of the firms whose doors are closed by fire *never* reopen for business again!

It's easy to see, therefore, why far-sighted business executives insist on Kidde fire protection to safeguard their business records. Kidde systems—like the record vault installation shown above – are tailor-made to *fully* protect the many different kinds of hazards you'll find in industry today.

With a Kidde system on the job, fire is out almost as soon as it starts. Kidde rate-of-temperature-rise detectors trigger the system at the first sign of a blaze, guarantee you round-the-clock protection even in case of outdoor power failure. Using safe, efficient carbon dioxide gas, Kidde systems snuff fire *without* a mess, will *not* damage records, papers or drawings!

Kidde systems have no falling weights, use no clumsy mechanical triggering methods. Pneumatic Control Heads insure instant and complete CO_2 discharge. All moving parts of a Kidde system are self-enclosed for safety, need no replacement after a fire, have easy-to-read indicators which show whether system is "set" or "released."

It's easy to get the best in fire protection – and it *can* mean the difference between profit and loss for you. For more information, write Kidde today.

Walter Kidde & Company, Inc.
1051 Main Street, Belleville 9, N. J.
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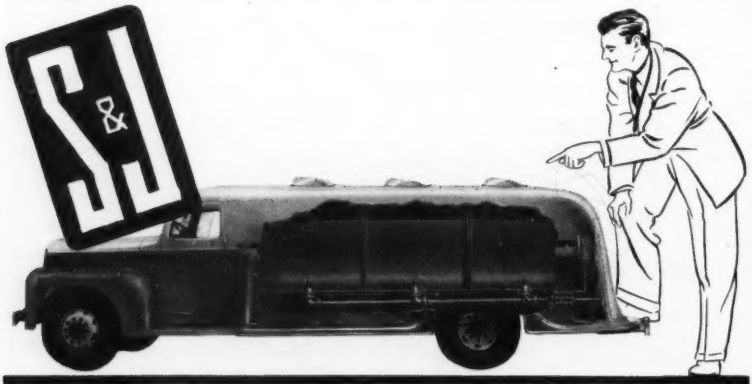

save 20% to 50% in installation costs

Every petroleum tank builder will tell you that he can save from 20% to 50% in the time it takes to install an S & J Hydraulic Internal Safety Valve System as contrasted to a mechanical valve system. The reason is simple. Hydraulic pressure is transmitted through copper tubing—nice to work with—extremely flexible—fast to install.

Compare the time of running copper tubing lines to installing sheaves and cables, goosenecks and bell cranks and various fittings to get around other equipment installed right in the path you would like clear for rods and cables. These hurdles are no obstacles to lines of copper tubing.

When you've finished installing an S & J Hydraulic System — you're through — you're not bedeviled by dust, mud, ice, sleet, corrosion, lack of lubrication, loss of cotter keys—all the things that plague a mechanical system. Go Hydraulic—it's far simpler, safer, and much cheaper in the long run.

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ALARM VALVES
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RETARD CHAMBERS
CIRCUIT CLOSERS
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TRIMMINGS
SPRINKLERS — ALL TYPES AND FINISHES
NEW! MODEL A GRIMES ACCELERATOR

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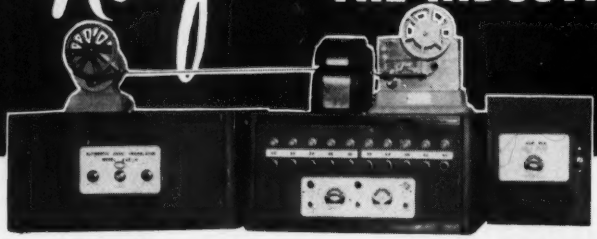
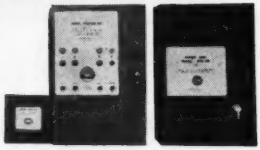


Class "A" Proprietary System
Fully Automatic
Sprinkler Supervision
Fire Detection



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...AT NO EXTRA COST

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Consult our engineering staff on your
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A unique opportunity to establish your own business
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NOTIFIER Automatic FIRE ALARM

NOTIFIER CORPORATION
239 South 11th St. Lincoln, Nebr.

PYROFILL*

roof decks fear no fire

PYROFILL Roof Decks are monolithic, reinforced gypsum concrete slabs poured in place over permanent formboards. PYROFILL concrete will not burn or support combustion; thus it more than meets rigid fire code requirements for Class "A" construction. In many cases, using PYROFILL permits substantially lower fire insurance rates.

SUPPORTED BY U.L. TEST! Over 150 top fire and building experts witnessed a spectacular test at the Underwriters' Laboratories in Northbrook, Illinois. Two types of roof decks were erected on identical structures, covered with built-up roofs of fiber insulation, asphalted felt and gravel; then subjected to fire from pressurized gasoline jet burners.

Results? The PYROFILL Deck remained intact, without fire break-through after one hour and 22 minutes. Even though the steel roof framing distorted 16 inches when subjected to temperatures in accordance with the Standard ASTM Time Temperature Curve, the PYROFILL Deck retained its structural integrity. The felt roof covering and insulation board appeared to be normal and unaffected from fire exposure throughout the structure. Also, the monolithic slab of PYROFILL gypsum concrete prevented dripping of bitumens from the combustible vapor barrier.

The 82-minute test emphasized the superior fire-resistance of PYROFILL gypsum decks. Complete data on the performance of *both* decks is contained in U.L. Report R3796.

COMPLETE INFORMATION Product data and details of the U.L. Test are available from your local U.S.G. Architects' Service Representative, Industrial Sales Engineer, or Dept. NF-64, 300 W. Adams St., Chicago 6, Ill.

*T.M. Reg. U.S. Pat. Off.

UNITED STATES GYPSUM

The Greatest Name in Building

GLOBE
AUTOMATIC
AIR PRESSURE MAINTENANCE
FOR DRY PIPE SYSTEMS

THIS DEVICE IS DESIGNED TO AUTOMATICALLY REPLACE SMALL LOSSES IN SYSTEM AIR PRESSURE IN ANY DRY PIPE SPRINKLER SYSTEM, AND AT THE SAME TIME NOT TO INTERFERE WITH THE NORMAL QUICK ACTION OF THE DRY PIPE VALVE SHOULD THE SYSTEM BE CALLED INTO ACTION.

IT CAN BE APPLIED TO ANY DRY PIPE SPRINKLER SYSTEM OR SYSTEMS WHERE THERE EXIST A NUMBER OF DIFFERENT VALVES REQUIRING VARIOUS STATIC PRESSURES, WHETHER THEY BE SUPPLIED BY AN INDIVIDUAL COMPRESSOR OR A GENERAL INDUSTRIAL AIR SUPPLY STORAGE TANK.

MANUFACTURED AND INSTALLED BY

GLOBE AUTOMATIC SPRINKLER COMPANY

2035 WASHINGTON AVE. PHILADELPHIA 46, PA.

OFFICES IN PRINCIPAL CITIES

Couple Pipe the Easy, Low Cost Way with New G-B GRUVAJOINTS

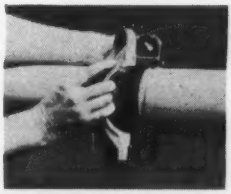
Now you can save up to 25% when connecting pipe for bulk runs and risers. Yes, contractors are saving money every day when they use new lightweight Gruvajoints. There's no flanging, no threading, no welding, and there's no need for heavy chain tongs or pipe wrenches. Gruvajoints are truly the modern way to couple pipe. Write today for free illustrated brochure on G-B Pipe Coupling Products. Gruvajoints are now available in 2", 2½", 3", 4", 5", 6" and 8" sizes.

LISTED by
Underwriters' Laboratories, Inc.
File EX 1741A and B

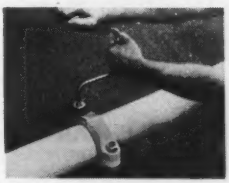
APPROVED by
Factory Mutual Engineering Division
Report Serial No. 13097

Install Gruvajoints in three easy steps

Grease gasket and center over pipe ends.



Lay housing halves into grooves and insert bolts.



Tighten the two nuts equally.

GUSTIN-BACON
manufacturing company
210 W. 10th St. Kansas City, Missouri

Kinnear
steel rolling
FIRE DOORS

The exclusive AKBAR Fire Doors

AUTOMATIC—with extra safety features

EMERGENCY EXIT— Doors can be raised after automatic closure

SAFETY GOVERNOR— Controls downward speed of door for safety

AUXILIARY SPRING— Starts doors with positive downward push

RELEASE LEVERS— Unlock closing mechanism in case of fire

BARREL LOCKS— Stop curtain at correct closed position

In addition to many other safety features, AKBAR Fire Doors permit regular *daily service-door use.* (Where *maximum* fire protection is not needed, regular non-labeled Kinnear Rolling Doors are preferred.) Available in a wide range of sizes. Write for full details.

The KINNEAR Mfg. Co.
FACTORIES:
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KINNEAR
ROLLING DOORS
Saving Ways in Doorways

Veteran Chief takes post-graduate training at Ansul fire school...you can too

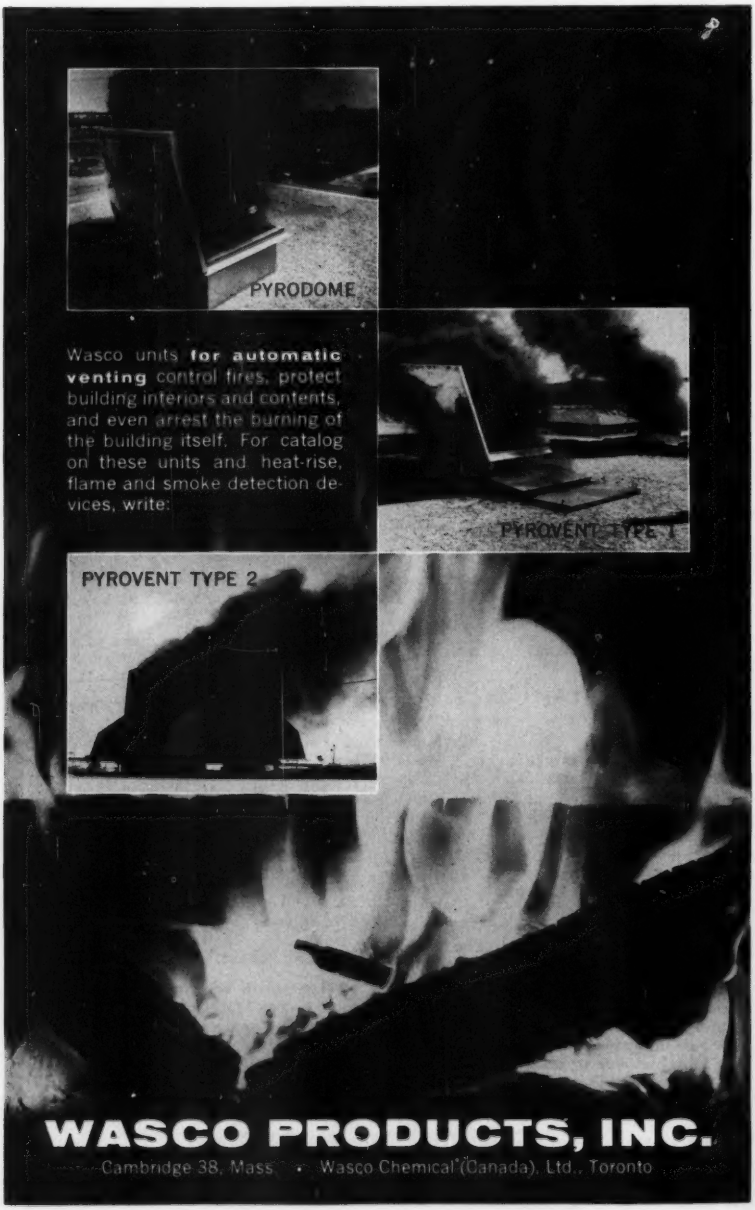
Throughout his entire career, Floyd Dumas has practiced what he preached . . . *you can't have too much fire training.* So it was logical that this veteran of 29 years' experience should attend Ansul's Fire Training School. As Chief of Fire Prevention for Parke Davis & Co., one of the nation's leading manufacturers of pharmaceuticals, his responsibilities are tremendous. The information Floyd took home from the Ansul School was promptly passed on to each member of his staff who will be better firefighters for it.

You, too, can have this training. Ansul is the nation's pioneer in the field of fire training, and the only manufacturer to offer this important service to its customers. It is just one of many "extra" services made available to all Ansul users. And there is no charge whatsoever. Since 1940, this unique school has graduated over 2,800 students from all over this hemisphere, parts of Europe, Asia, and the Middle East.

Training at the Ansul Fire School is of the practical kind. The classroom is Ansul's five-acre test field containing all the latest equipment, and staffed by expert instructors. You owe it to your business, to your position, to learn more about the Ansul Fire Training School.

Get in touch with your local ANSUL MAN through the yellow pages of your phone directory, or write to THE ANSUL CHEMICAL COMPANY, DEPT. QN-10, MARINETTE, WISCONSIN.

ANSUL


PYRODOME
Wasco units for automatic venting control fires, protect building interiors and contents, and even arrest the burning of the building itself. For catalog on these units and heat-rise, flame and smoke detection devices, write:
PYROVENT TYPE 1
PYROVENT TYPE 2
WASCO PRODUCTS, INC.
Cambridge 38, Mass. • Wasco Chemical (Canada), Ltd., Toronto

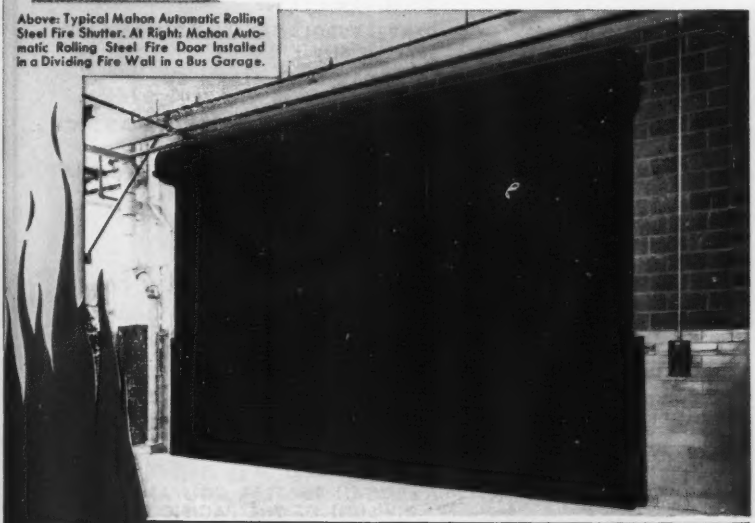
Automatic Rolling Steel
FIRE DOORS *and* WINDOW SHUTTERS
PREVENT SPREAD *of* FIRE!

You need good automatic fire doors in fire walls, corridors, and vertical shafts . . . in some cases automatic rolling steel window shutters are necessary to protect your building and its contents from fires which may originate in nearby buildings. Many, many cases are on file which confirm that timely action of automatic rolling steel fire doors and window shutters have confined a fire to its point of origin and permitted its being extinguished with comparatively small damage. Make a survey of your building now, and don't delay action. You will find a Mahon Automatic Rolling Steel Fire Door or Window Shutter to meet each of your requirements—all bear the Underwriters' Label. These automatic fire doors may be operated manually or mechanically in every day use. If a fire shou'd break out while they are in the open position, the automatic mechanism will close the door, cutting off drafts and preventing the spread of the fire. See Sweet's Files for complete information, or write for Catalog G-55.

THE R. C. MAHON COMPANY
Detroit 34, Michigan • Chicago 4, Illinois

Manufacturers of Automatic Rolling Steel Fire Doors and Window Shutters. Also Many Types of Standard General Service Rolling Steel Doors and Grilles, Insulated Metal Walls, and Steel Deck for Roofs, Floors and Partitions.

Above: Typical Mahon Automatic Rolling Steel Fire Shutter. At Right: Mahon Automatic Rolling Steel Fire Door Installed in a Dividing Fire Wall in a Bus Garage.



MAHON ROLLING STEEL FIRE DOORS and WINDOW SHUTTERS

Nation Wide
Central Station Protection Services

Sprinkler Valve Alarm — Complete Sprinkler Supervisory — Manual Fire Alarm — Automatic Fire Alarm — Temperature Alarm — Oil Burner Supervision — Burglar Alarm — Hold-Up Alarm — Vault & Safe Protection

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HOUSTON, TEXAS	**McCANE-SONDOCK DETECTIVE AGENCY** **1612 Austin Street**
LOS ANGELES, CALIFORNIA	**MORSE SIGNAL DEVICES OF CALIFORNIA** **211 So. LaBrea Avenue**
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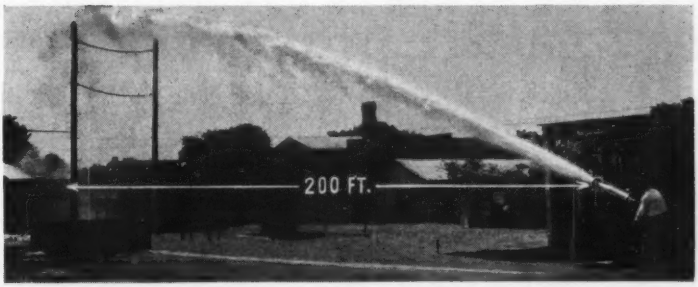
SAN FRANCISCO, CALIF.	**AMERICAN BURGLAR COMPANY, DIVISION OF THE PACIFIC FIRE EXTINGUISHER COMPANY** **165 Jessie Street**
WASHINGTON, D. C.	**FEDERAL ENGINEERING CO., INC.** **1004 Sixth Street, N.W.**



NEW, LARGE-CAPACITY AER-O-FOAM PW-50 NOZZLE

Delivering as much as 4600 GPM of fire-fighting foam, the new Aer-O-Foam PW-50 Nozzle brings new dimensions to effective Aer-O-Foam fire-fighting techniques. This multi-purpose nozzle extinguishes fires on the ground, in sludge or settling pits and in ponds, and in large dike areas. It may be mounted on foam trucks, fire boats or crash trucks, or may be used with fixed piping near process units in refineries and chemical plants.

The PW-50 can be shifted quickly from straight stream to spray stream operating and vice versa. It operates on both foam solution and water alone. Range of straight foam stream extends to 200 feet at top pressure; spray stream operation produces an effective foam spray pattern as long as 88 feet.

For better control of fire in flammable liquids, you'll want full information on this new nozzle. Write today.

NATIONAL FOAM FIRE PROTECTION SYSTEM

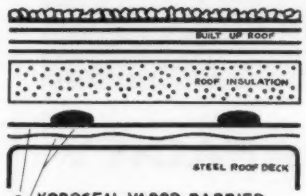
NATIONAL FOAM SYSTEM, Inc.
West Chester, Pa.

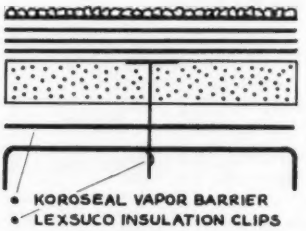
The only company exclusively engaged in the design, development and manufacture of foam fire protection equipment and chemicals.

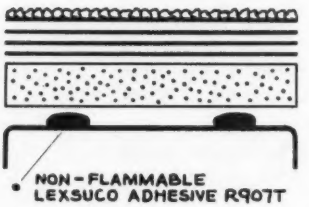
DON'T GAMBLE WITH FIRE

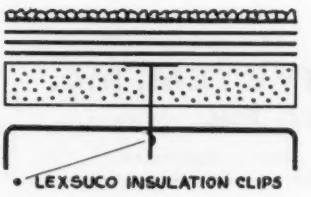
. . . Here's Your Answer To Assured Building Fire Protection

FACTORY MUTUAL APPROVED
LEXSUCO CONSTRUCTIONS









LEXSUCO ROOF VAPOR BARRIER AND SECUREMENT CONSTRUCTIONS make no contribution to the spread of fire within a building and eliminate hazardous combustible bituminous materials between a steel roof deck and insulation.

. . . EVEN WITHOUT AUTOMATIC SPRINKLERS, the Lexsuco Roof Constructions give positive protection against the spread of fire on the underside of a steel roof deck.

OVER 18,500,000 SQUARE FEET of Lexsuco Roofs are providing fire protection for 475 organizations . . . Such as —

ALUMINUM COMPANY OF AMERICA
THE AUSTIN COMPANY
CHRYSLER CORPORATION
DOUGLAS AIRCRAFT COMPANY
THE FORD MOTOR COMPANY
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GENERAL MOTORS CORPORATION
B. F. GOODRICH COMPANY
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REPUBLIC STEEL CORPORATION
GOVERNMENT SERVICES

DON'T GAMBLE WITH FIRE! . . . Investigate Lexsuco Fire Retardant Roof Constructions today . . . Cost is comparable with conventional methods.

For complete information on Lexsuco Roof Constructions write or call today.

Sweet's

LEXSUCO INC.

4817 Lexington Ave., Cleveland 3, O.

RELIABLE SPRAY SPRINKLER

- Greater Coverage!
- Lower Ceiling Temperatures!
- Faster Cooling of Hot Fire Gasses!
- Better Fire Extinguishment with Less Water!
- Fewer Sprinklers Operating Adjacent to Fire Area!

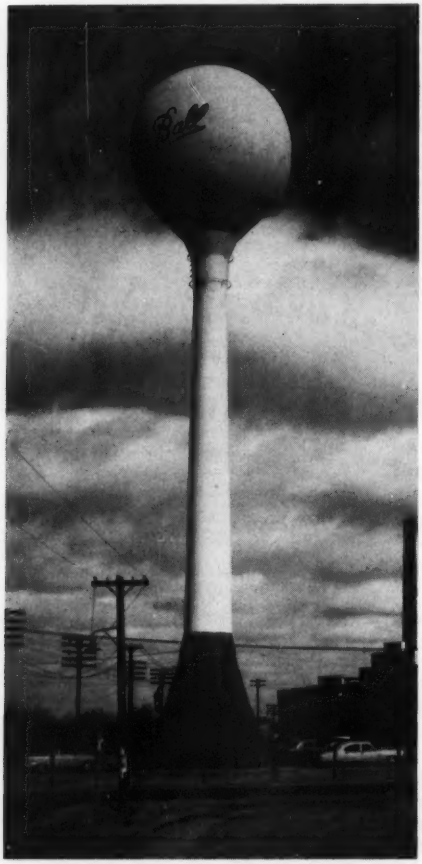
Incorporating the new principle of water distribution, the Model "C" Spray Sprinkler is another example of Reliable's leadership in new product design. All Reliable Sprinkler Devices are the assurance of the ultimate in fire protection . . . and have been protecting life and property for over 30 years! Reliable Sprinkler Devices are distributed . . . installed and serviced by Reliable's chain of licensed representatives located throughout the United States, Canada and foreign countries. A Reliable representative is as near as your phone . . . Call him for a system designed to your specific needs!

Constant Fire Protection That's Always "Reliable"!

THE RELIABLE AUTOMATIC SPRINKLER CO. INC.

HORTON WATERSPHERE

Reduces Insurance Cost at Ball Brothers Company



Ball Brothers Company Inc., manufacturers of glass containers, installed a 100,000-gallon Watersphere to serve as a secondary water supply for their Hillsboro, Illinois, plant's sprinkler system. A pond on the plant property serves as the primary water source for the sprinkler system.

With the installation of the sprinkler system and Horton Watersphere fabricated and erected by the Chicago Bridge & Iron Company, the Ball Brothers Company Inc. received an insurance cost reduction of 90 percent and estimates that the entire cost of both the sprinkler system and the Watersphere will be paid for in insurance savings over approximately ten years.

At the Hillsboro plant the company manufactures a line of amber glass containers. Annual production capacity reaches approximately 800,000 gross bottles, jugs and jars. The Hillsboro plant has 37 buildings and covers a ground area of 28 acres with a total floor area of 180,195 square feet. A 1,309-head sprinkler system covers all areas of the Hillsboro plant. Culligan Fyrprotexion installed the sprinkler system served by the Horton Watersphere.

CHICAGO BRIDGE & IRON COMPANY

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Plants at Chicago, Birmingham, Salt Lake City and Greenville, Pa.

Champion Fire Fighters

COMPRESSION TYPE FIRE HYDRANT

M H

Above all else, M & H Fire Hydrants are reliable and dependable fire fighting equipment. They deliver when the need arises, if there is water in the mains. Their high flow efficiency is due to an unobstructed, large waterway which has the same diameter its entire length.

Dry top, dry barrel when not in use, eliminates danger of damage by freezing. Operating parts are bronze or bronze bushed. Easy to lubricate.

Manufactured according to A. W. W. A. standard specifications or Underwriters and Factory Mutuals approved; in conventional model, traffic model or flush-type model; sizes 4¼, 4½, 5¼ and 6¼. For complete information, address

M&H VALVE AND FITTINGS COMPANY
Anniston, Alabama

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

Send For This FREE Catalog!

. . . 28-page illustrated booklet contains factual information on methods of fire detection, fire prevention, fire control and fire extinguishment.

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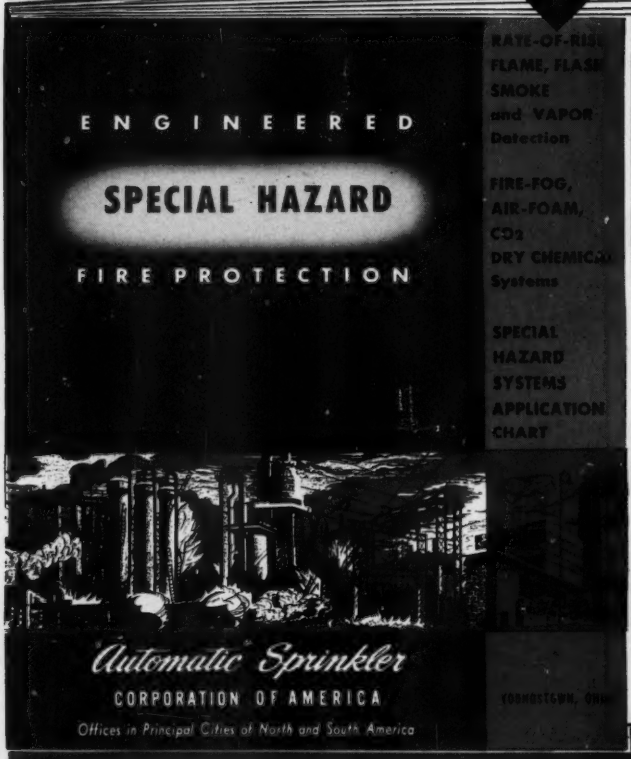

"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA
Dept. S.H. — Box 360 — Youngstown 1, Ohio
Please furnish me with a copy of your Catalog 73—
"Engineered SPECIAL HAZARD Fire Protection."

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240 Progressive Communities

give their taxpayers a helping hand

In recent years these 240 cities and towns have cast their votes for Municipally owned and controlled fire alarm systems. They have installed brand new coded telegraph systems or made substantial replacement of existing ones. In addition, 1800 other cities and towns are safely protected by coded systems with similar features.

The Fire Chief who recommends this system gives his community — and the taxpayers — a two-way saving . . .

- Loss of life and property damage are decreased because Gamewell is the only system which gives *fast, positive* alarm.
- Reduction of insurance rates by upgrading Fire Underwriters' classification saves substantial sums for property owners.

You can bring these same advantages to your community. For the full story on safe, sure alarms with a Municipal Fire Alarm System, ask us about a free survey. And for new ideas on how to present this story to other people in your community, write for the booklet: "Conversation or Organization".

Remember — a Gamewell System is FIRST when Seconds Count!

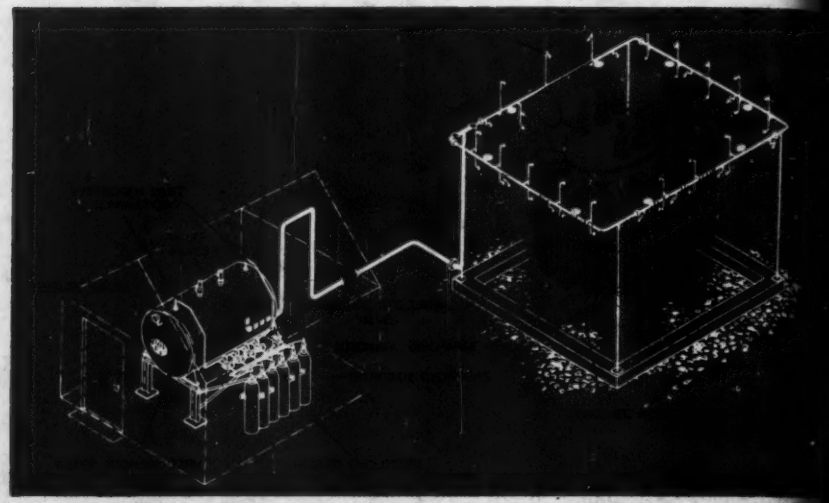
GAMEWELL®

THE BOX IS POSITIVE

Reduces Human Error

THE GAMEWELL COMPANY
NEWTON UPPER FALLS, MASS.

Grinnell Mulsifyre Protection with a Limited Water Supply

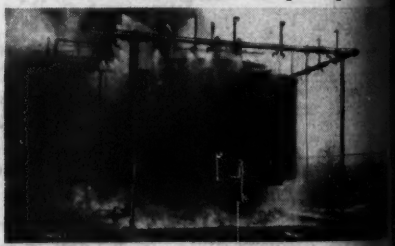


You need no longer be without water spray protection simply because your hazard is distant from city water mains. Grinnell's new limited water supply Mulsifyre System provides automatic detection and prompt water spray protection in extinguishing fires while still small, and in preventing their spread with possibly serious damage.

Water spray protection, of course, presupposes water under pressure. Grinnell's limited water supply system successfully achieves this through the use of nitrogen gas, stored in cylinders under high pressure, which drives the water from the storage tank at spray-forming velocities. As with all Grinnell Fire Protection Systems, the component parts of the limited water supply Mulsifyre System are fully listed by Underwriters' Laboratories and meet specifications covered in NBFU and NFPA Standards.

Your particular hazard will be thoroughly analyzed by the Grinnell Fire Protection Division, which introduced water spray protection in America — and has the widest possible background experience in its use. Full consideration will be given to the property to be protected as well as to all other adjacent exposure hazards.

Let a Grinnell Fire Protection Engineer tell you more about this system. Grinnell Company, Inc., 274 West Exchange Street, Providence, Rhode Island. Branch offices in principal cities.



A Grinnell limited water supply Mulsifyre System operating to extinguish fire under test conditions.

GRINNELL *Mulsifyre*

EMULSION EXTINGUISHMENT OF OIL FIRES